Index to Volume XXV

JUNE TO DECEMBER

1910

The Journal of Electricity, Power and Gas

Published by the Technical Publishing Company

San Francisco, California

Index to Volume XXV

Illustrated articles are designated by an asterisk (*), editorial by a dagger (†), and industrials by double dagger (‡).

Author's Index

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 1 | SAN FRANCISCO, JULY 2, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS
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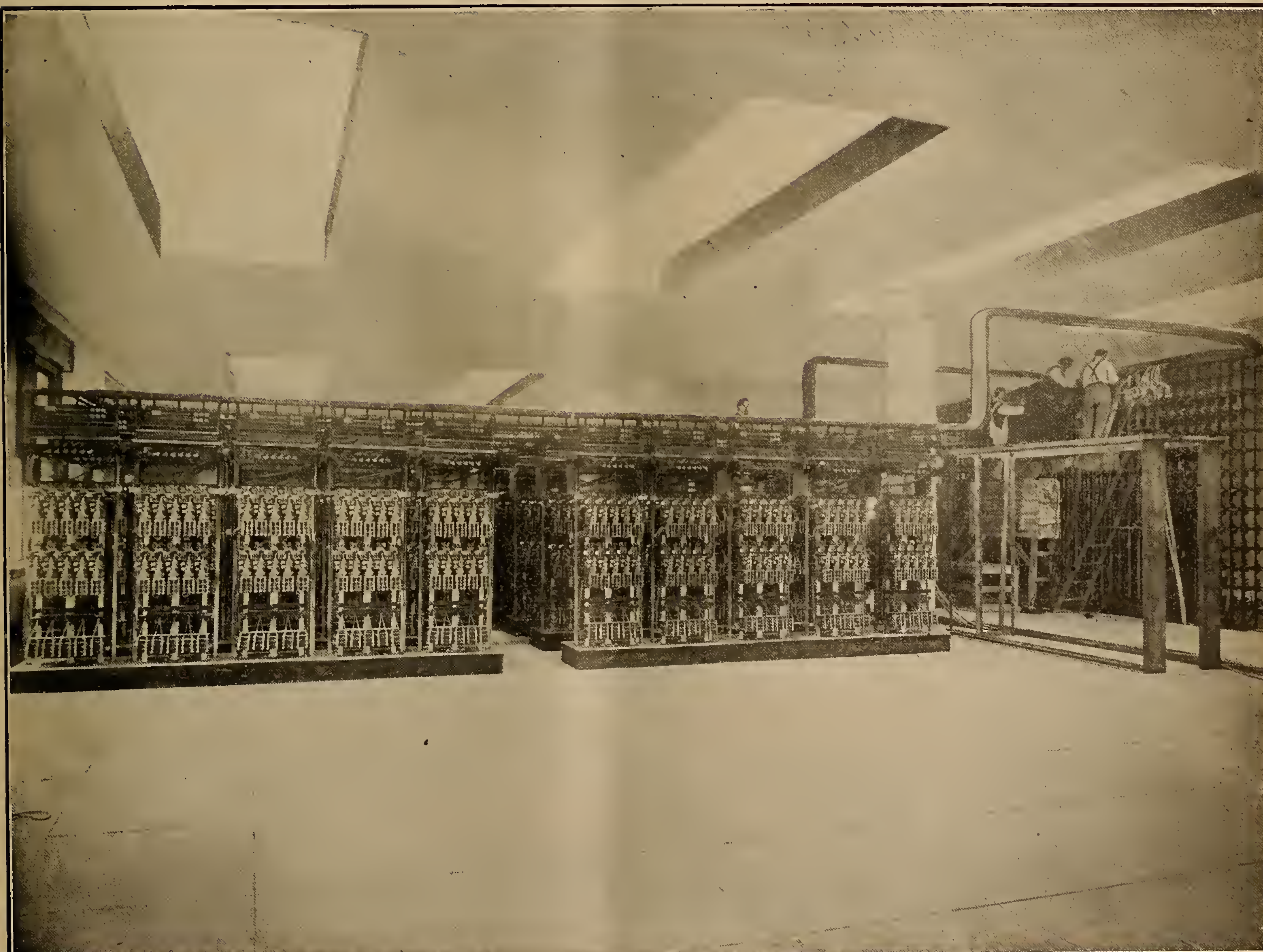
VOLUME XXV — SAN FRANCISCO, JULY 2, 1910. — NUMBER 1

TELEPHONE ENGINEERING AROUND THE GOLDEN GATE[1]

BY ARTHUR BESSEY SMITH.



Automatic Switching Equipment in San Francisco Office of the Home Telephone Company.

The requirements to be considered in designing a telephone system for this region may be briefly stated as follows:

1. A system which shall give satisfactory telephone transmission between all points in the whole territory.

2. A system which provides satisfactory accessory conditions such as ease, rapidity and accuracy of completing and controlling connections, methods of charg-

[1]Abstract of paper presented at the 27th Annual Convention of the American Institute of Electrical Engineers, Jefferson N. H., June 27-30, 1910.

ing for service and means for discrimination in the same.

The consideration of these general requirements as applied to the case in hand causes their expansion into ten conditions, viz.:

1. Quiet, clear, transmission over all talking circuits.

2. Easy, quick and accurate completion of local connections within each exchange district.

3. Provision for the cosmopolitan nature of the population especially regarding the diversity of languages.

4. Measure service.

5. Free service on calls to certain classes of stations.

6. Private branch exchange business.

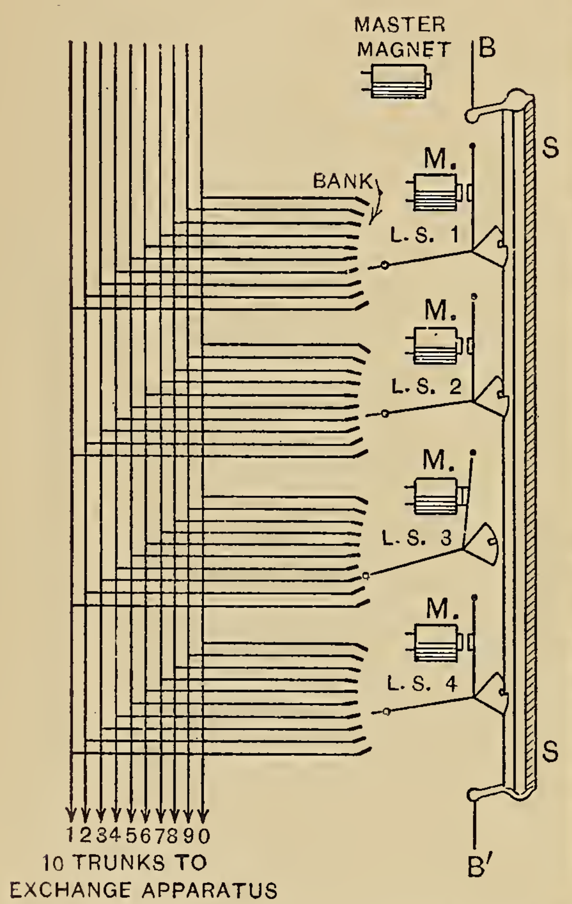


Fig. 2. One Hundred Individual Line Switches.

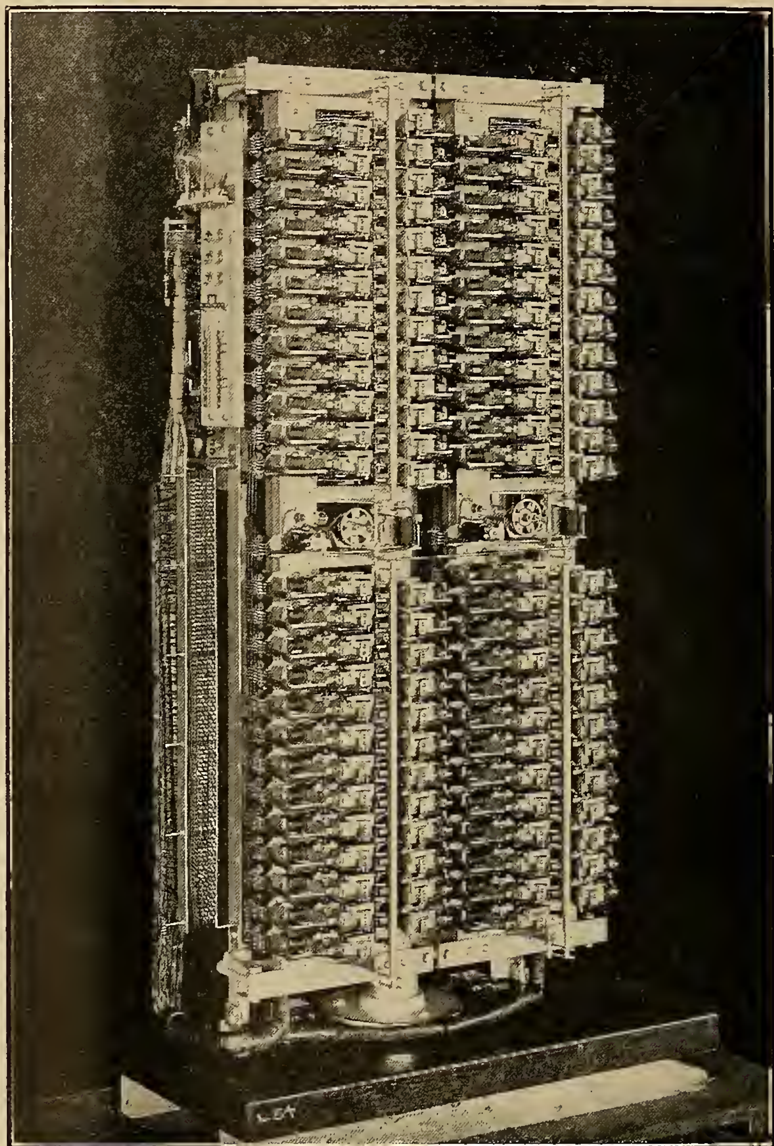


Fig. 3. Grouping of Line Switches in San Francisco Offices.

7. Quick and accurate completeion of calls between exchange districts, especially between San Francisco and Oakland.

8. Accuracv in charging the accounts of credit toll users.

9. Credit and cash toll work between exchanges.

10. Provision for the harmonious mutual working of different types of apparatus used in the several exchanges.

In the Spring of 1905 the interest of San Francisco citizens was aroused by a small exhibit of the automatic system. This exhibit was, however, destroyed by the fire in the Spring of 1906. While the city was recovering from the effects of the disaster the attention of constructionists was diverted to Oakland, where an automatic system was installed and completed in May, 1907. It is of the three-wire trunk release common battery type, with Keith type line switches. Three offices are in service, Main, East and Berkeley, with two district stations connected to the Main office.

Work was again taken up in San Francisco, with the result that a system was installed in 1909. By the time the San Francisco order was placed the two-wire automatic equipment had been perfected and was accordingly used. Four offices are at present operating and are designated as Main, Howard, South and West.

Local Exchange Apparatus.

Each Oakland subscriber's line in any office terminates in a line switch. These line switches are grouped in units (see Figs. 2 and 3) of from 50 to 100 each. All the line switches in a unit have access to a group of ten trunk lines. The general arrangement of switches is shown in Fig. 4. When any subscriber initiates a call, his line is automatically connected to an idle trunk line, a. This trunk is preselected, so that

there is no loss of time, the connection being practically instantaneous. The various groups of ten trunks each, which come from the banks of the line switch units, terminate in first selector switches.

To the first or bottom level of bank contacts in all first selectors in Oakland are attached trunk lines leading to the Main office. The second level has the trunks leading to the East office and the third level those to the Berkeley office. Taking the East office for example, the trunks from the second level are termed local trunks, b, since they run to second selectors in the same office. Those from the first and third levels, however, are outgoing trunks, c, for they run to the other offices, Main and Berkeley. These outgoing trunks go through repeaters, which serve the chief purpose of supplying talking current to the calling subscriber from his own office, while still enabling him to send impulses to the distant office to control the switches.

Fig. 1. Map of San Francisco and Oakland.

ing or circuit-changing member. It determines upon what switch or magnet the vertical impulses shall act. At the close of any series of impulses over the vertical wire, one impulse is always sent over the rotary wire to shift the connections in the switches so that the next series over the vertical line will be effective on the next operation to be performed.

When the called subscriber answers, a relay in the connector is operated which switches the rotary wire from negative to positive battery, thus supplying talking current to the calling subscriber.

The simultaneous grounding and clearing of both vertical and rotary lines causes the switches to be released and restored to normal position.

The grouping of switches in San Francisco is somewhat different from that of Oakland owing to the introduction of secondary line switches. A typical arrangement is shown in Fig. 5.

Each subscriber's line terminates in a primary line switch. These switches are grouped in units of 50

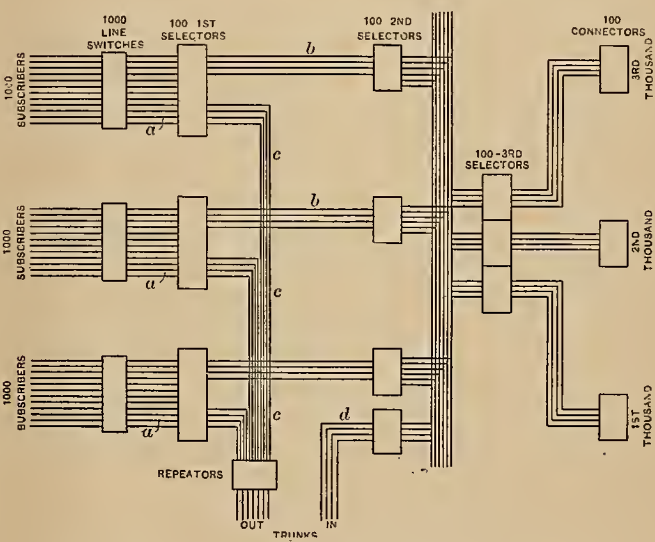


Fig. 4. Trunking in Oakland.

The second selectors in each office have the duty of picking out the desired thousand group and of selecting an idle third selector in that thousand. The third selector chooses the hundred group and the connector makes the final connection to the line of the called subscriber. In practice the connector switches are mounted on the same frame with the line switches with whose lines they connect. Incoming trunks, d, from other offices are wired to second selectors whose banks connect with trunks common to the local apparatus.

The two line wires which extend from any Oakland office to a subscriber's station are termed "vertical" and "rotary" respectively. In the office each is connected to a relay which has its other terminal attached to a battery of storage cells. The other (positive) terminal of the battery is grounded. The dial or calling device at the sub-station, when operated, grounds each wire in a definite way, operating the relays, and through them the switches.

The vertical wire is the impulse transmitting member, for over it are sent at various times the exact number of impulses required to set the switches according to the digit called. The rotary wire is the switch-

each, and have access to ten trunks, as described for Oakland. But here the difference begins. The trunks from the primary line switches are carried to secondary line-switch units, where each trunk terminates in a secondary line switch. Each unit group of secondary line switches has access to a group of ten trunks, d, each of which ends in a first selector. These secondary line switches are exactly like the primary switches in function, for they pre-select the idle trunks in exactly the same way.

The purpose of using primary and secondary line switches is to enable any subscriber's line to use any first selector switch. This is in the interest of economy. Where only a small number of trunks are available for selection, the efficiency is relatively low. For instance, it has been found in automatic telephone work that ten trunks in one group can be depended upon to handle about 225 busy-hour calls, or 22.5 calls per trunk. Twenty trunks in one group will handle about 575 busy-hour calls or 28.75 calls per trunk. By arranging one hundred first selectors in one group 4000 busy-hour calls may be successfully handled. If arranged in groups of ten each it would take about 180 first selectors to carry the same load.

The intermediate distributing frame placed between the primary and secondary line switches is to render more easy the interconnections by means of which the traffic is equalized on all the first selectors.

Since the first selectors select the office in which the called number is located, all levels but one will be connected to trunks to other offices. These outgoing trunks, c, are led through secondary line switches so that any inter-office trunk is made available to any first selector. For instance, if we consider a call from Main to South, every trunk leading to the South office from Main will be available for use by every first selector in the latter office. By arranging all the trunks in a common group, considerable saving in trunk cable is secured. Though varying with the local conditions, the saving has in certain cases been as high as 40 per cent.

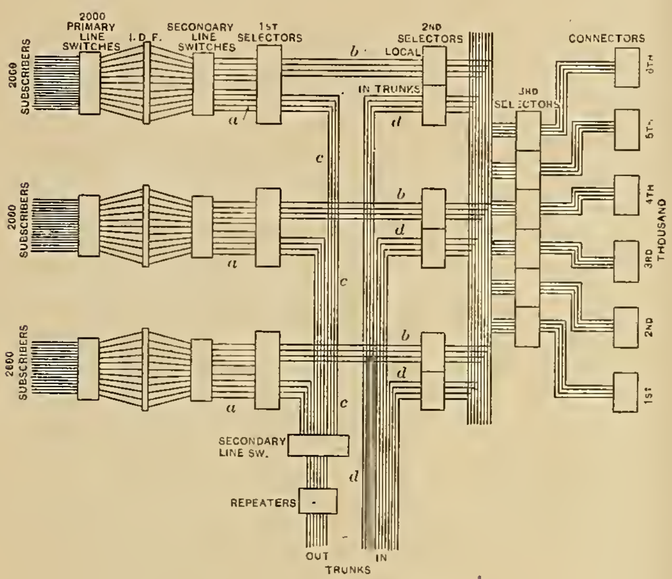


Fig. 5. Trunking in San Francisco.

The incoming trunks, d, from other offices terminate in second selectors which have access, in common with local second selectors, to third selectors. The grouping from here on is identical, in general, with that of the Oakland Exchange, and the connectors are mounted on the same frames with the primary line switches, whose lines they are designed to reach.

The exact method of operation differs radically from that used in Oakland, for the San Francisco apparatus is controlled by the subscriber over two wires with no earth return. This greatly simplifies the subscriber's telephone and gives many structural and operating advantages.

The two subscriber's line wires are known as positive and negative, indicating the terminal of the battery to which each is attached through the windings of the line relay. The series of impulses for stepping up the wipers of the switches is caused by the dial or calling device, which opens and closes a normally closed pair of contacts. The line relay follows these impulses and repeats them to the magnets which move the wiper shaft.

The switching of the circuit to the next switch or operation depends upon the time interval between one series of impulses and the next. During a series, the circuit-changing member is held by a catch, which is released when the impulses cease to come. The release is accomplished by simply opening the line circuit by hanging up the receiver. This momentarily brings into action the release magnets which restore all switches to normal.

Telephone Transmission. The nature of the completed circuit between two subscribers has a vital effect on the quality and loudness of transmission. Freedom from external disturbances is to be secured by properly transposed wires and perfect electrical balance. The former is secured by a large use of telephone cable, the latter by high insulation and properly designed apparatus. In the telephone switchboards installed in San Francisco and Oakland every talking circuit is balanced from one end to the other. Fig. 6 gives in simplified form the transmission circuit between two subscribers in separate offices. From the calling telephone to the called telephone there are four "bridges" or shunt paths. Each of these is a relay or a pair of relays, all of which are highly inductive, so that little loss is occasioned to telephone current. The impedance of each path from line to earth is made as nearly as possible equal to that of the mate. No extra coils are bridged to one side of the line, and none are inserted

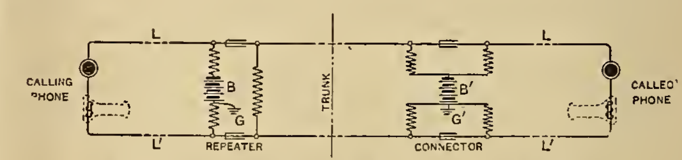


Fig. 6. Simplified Talking Circuit. Inter-office.

in series. All auxiliary circuits are handled by a third wire within each office, leaving the talking circuit clear for its proper functions. The trunks are two-wire with no earth return circuits during conversation. Each subscriber is supplied with talking current from a battery in his own office. No repeating coils are used in any portion of the circuits.

Method of Calling. The method of calling a number on the automatic system briefly consists in rotating a small dial by the finger, making one motion for each digit in the call number. The dial used in San Francisco is shown in Fig. 7. To assist the memory, the offices are designated by letters instead of figures. The code is as follows:

C Main office.
J Howard office.
M South office.
S West office.

Thus, a telephone whose number is 22785, appears in the directory as J-2785. It is served by the Howard office, though this is of little importance to the subscriber.

The manipulation of the dial for an average call number takes about five seconds, after which the bell of the called station begins to ring without further action on the part of the calling subscriber. The ring is intermittent and ceases when the called subscriber answers.

Instantaneous release of the switches is effected by hanging the receiver on the hook. This is of interest chiefly to those who have two or more calls to make in succession.

Diversity of Languages. The method of calling above described is of special convenience to the many people who speak only foreign languages. The Arabic numerals are common to practically all nationalities represented in San Francisco except the Chinese. For the latter a special lettering has been made which is shown in Fig. 8.

Fig. 7. San Francisco Dial.

Fig. 8. Chinese Dial.

Measured Service. One of the conditions met in managing a telephone system in a large city is the desirability of charging for the service in proportion to the amount of service rendered. This is ordinarily done by attaching a meter to each subscriber's line. The requirements of a meter are as follows:

1. It must register only once for each completed connection, rejecting those in which the called station fails to answer.

2. It must make no charge for connection to certain classes of telephones, such as fire, police, information and complaint desks, etc.

The Oakland exchange is operated on the flat rate basis for all calls originating and terminating within the exchange, which includes the suburb of Berkeley. In San Francisco measured service is required.

The meter in an automatic telephone system is attached to the line switch. As above mentioned, it must not operate until the called station answers. Therefore, the latter act must cause some change in electrical condition at the line switch which will cause the meter to register. The line switch of the calling station and the connector which picks up the called line may be in different offices with 1st, 2nd, and 3rd selectors and a repeater in the circuit between. The called station can control the connector and through it the condition of the line leading back to the line switch. Two changes in condition are available, reversal of current and change of current strength. The latter is undesirable on account of its interfering with conversation to stations set aside for free service. The former seemingly necessitates some form of polarized magnet. As it was desired to avoid the use of permanent magnets, a two-coil meter was devised. It is so arranged that when the called station answers, the current supplied to the latter operates the relay which reverses the current supplied to the calling line. This causes the meter to record one call. Neither coil alone will cause registration, and the apparatus has a range from 0 to 1500 ohms line resistance. Its line coil is of low resistance and is short-circuited during conversation. The reversal of current for operating the meter is accomplished in such a manner as not to cause inconveniences to the calling subscriber.

Free Service. Since the connector is the switch in which occurs the reversal of current which operates the meter, the means for giving free service must effect this part of the apparatus. It is done by grouping all free service lines such as information, police, etc., into one or more hundred groups, each group served by a set of connectors. All these connectors are so wired that the current flow to the calling subscriber is not reversed when the called station answers, consequently no register is made.

There is one class of calls for which, strictly speaking, no charge should be made, and that is calls which result in the wrong number being obtained. The meter makes no discrimination here, and if the called station answers, a call will be recorded. However, experience has shown that such a small per cent of wrong numbers are obtained that they may safely be neglected. This is especially true if wrong calls due to carelessness in the use of the dial be omitted. For these it is right to expect the subscriber to pay. The same is true of regular manual practice, for if a subscriber calls for the wrong number and gets it, he is expected to pay for it.

Cash measured service is furnished by means of coin boxes attached to the line wires at the subscriber's stations. No coin is required to be deposited in order to call. When the called station answers, the reversal of current operates a magnet in the coin box which short circuits the transmitter and places a shunt in parallel with the receiver. This prevents the transmission of speech, but allows the user to hear faintly the voice of the called subscriber. By dropping a coin in the chute, the shunts are removed, so that conversation can take place.

When a call is made to a free station as above described, no reversal of current takes place, so that the calling subscriber is not forced to make a payment.

Private Branch Exchanges. In both Oakland and San Francisco the nature of the business makes quite a large number of private branch exchanges profitable to the subscriber and to the operating company. These boards are manually operated and have several trunks connecting them with the nearest public exchange office. Each business house is listed under one number in the directory. When a public subscriber selects the call number the connector switch must automatically select an idle trunk to the private branch board. This is done by a special type of switch known as the rotary connector. It responds to the impulses for the tens and units digits of the call number, but immediately thereafter acts as a selector until an idle trunk is found. These rotary connectors are grouped in hundreds so that in providing for this special service the call numbers are set aside in blocks of one hundred each. Thus in the Main office, San Francisco, the 1100, 1200, 2100, 2200, 3100, 3200, 4100, and 4200 hundred units are set aside for private branch exchange service and no number in them assigned for individual lines.

The trunks to private branch board are treated exactly like subscriber's lines in the public exchange, each being wired to a line switch for calls to the automatic system. They terminate in jacks and signals on the manual private boards and can be used for establishing connections either to or from the subscriber. The operator is provided with a calling device which may be switched by keys to any cord circuit. With this the operator calls into the automatic exchange and

arrangements are made so that complete double supervision is secured on all calls.

In the case of a private branch exchange having sufficient magnitude of business to require it, the trunks leading from connector banks may be made one-way only and reserved for calls to the branch board. There will then be installed as many trunks from the latter to the public exchange as are necessary, these trunks being attached to line switches. The number of trunks is not limited by the number of contacts in a level of the connector bank.

Transbay and Suburban Toll. For the suburban work between San Francisco and Oakland it was thought best to use what is known as the "rapid fire" method. Accordingly provisions were made for allowing the recording operator at San Francisco, for example, to complete the call into the Oakland exchange by a calling device in San Francicso, and to allow the conversation to proceed at once. This virtually makes the recording operator a line operator and entirely dispenses with the services of a line operator to complete the connection in the distant office.

The recording operator is of course obliged to ask the subscriber who originates the call for his telephone number so that the cost of the toll service may be properly charged. It is to be expected that, either by accident or intention, wrong numbers will sometimes be given. To prevent error from this source a system of back checking has been devised.

Two Three-wire Operation. The work of interconnecting the two exchanges was rendered more difficult by the fact that the Oakland apparatus is three-wire, while that of San Francisco is two-wire. The two-wire system requires only the opening and closing of the line circuit. The three-wire system requires each line wire to be grounded in a certain order. The San Francisco recording operator using a two-wire calling device was required to operate three-wire selectors and connectors in Oakland, in some cases as far as thirteen miles away. This was done by means of repeaters which handle the impulses somewhat like a telegraph-repeater, except that it is necessary to transmit impulses only one way.

Each transbay trunk from San Francisco to Oakland ends in multiple jacks with visual busy signals on the San Francisco suburban board, and in a first selector-repeater in the Main office in Oakland. This switch is a first selector, to pick out trunks to the desired office in Oakland, combined with a repeater arrangement to convert the simple make and break of the two-wire system into the alternate grounding of vertical and rotary lines required by the three-wire system. The release of the connection as well as proper supervision is also provided in the repeater.

The operator is provided with a set of plugs and cords with which to connect incoming trunks from San Francisco subscribers to outgoing trunks to Oakland. A calling device is mounted on the keyboard and arranged to be switched into any cord circuit by keys. When a call comes in over an incoming trunk, it is answered by inserting the answering plug of a cord into the proper jack. An idle outgoing trunk to Oakland is selected by inspection of the visual busy signals, and the calling plug of the cord in use inserted into the jack. The calling device is then switched into the cord circuit and rotated in accordance with the desired number. This operates the switches in Oakland.

The release of the three-wire Oakland apparatus calls for the momentary simultaneous grounding of the vertical and rotary lines. The two-wire first selector repeater at the Oakland end of the transbay trunk requires only the simple opening of its line circuit. By a suitable arrangement this is made to cause the release of the three-wire apparatus. The trunks from Oakland to San Francisco are operated straight two-wire, and hence are simpler than those just described. For the sake of securing sharper, better signals the trunks are wired through the first selector repeaters in the San Francisco main office. Supervision is secured by marginal relays.

APPRAISAL OF THE PUBLIC DOMAIN.

While legislation is under consideration by Congress looking to a more effective conservation policy by the Government than is now possible, Uncle Sam meantime is making the most of his present opportunities and is pushing vigorously ahead in the real work of securing the best development of natural resources. What is known as the "land classification" office-report of the Geological Survey for the month of May contains some live statements.

During the monh the survey reported on 1,097,261 acres of coal land withdrawals of which 329,334 acres were classified as non-coal lands. The coal lands were valued, by 40-acre units, according to the estimated tonnage, and the aggregate price fixed was $58,508,120. Under the minimum price fixed by law, which obtained in the disposal of coal lands until within the past few years, the price of these lands would have been but $13,320,390, a difference of $45,000,000 as a result of one month's work. Heretofore coal land valuations have been based entirely upon the field work of survey geologists but of the above mentioned acreage 14,962 acres of California lands, with a valuation of $585,086, were priced on the basis of a report by a special agent of the General Land Office. This tract of land is the first California land to be classified as coal. New withdrawals of lands, containing more or less coal and subject to future classification and valuation, were made covering 179,561 acres.

Withdrawals Covering Water-Power Sites.

Temporary withdrawals were made covering 27,889 acres along western rivers designed to reserve and protect federal water-power sites, subject to revision after field examination and to further final disposition following legislation by Congress. Restorations were also made covering 25,512 acres of land withdrawn on account of power sites, which was found upon further examination to be non-essential to the Government control of the power. The policy of the survey in making withdrawals and restorations is stated to be that withdrawals of land for all purposes of protection of different resources are made to include as little public land as is deemed necessary to fully protect the Government at the time of the withdrawals, while as fast as subsequent examination of available data or field investigation shows withdrawn areas to be unnecessary to the Government protection such areas are restored to public entry.

OIL AS FUEL ON THE CANAL ZONE.

The first installation of burners for California crude oil was made in the two locomotive type boilers in the Mount Hope pumping station early in 1908. At the present time practically all of the stationary boiler plants along the line of the Canal, the dredges, clapets and other marine equipment on the Pacific end of the Canal, as well as twelve 20-inch by 26-inch mogul locomotives on the Panama railroad main line use oil exclusively. The Sanitary Department also uses this oil for spreading over stagnant water to assist in mosquito extermination.

An article published in The Canal Record of November 11, 1908, gave the terms of the revocable license, granted on January 10, 1906, to the Union Oil Company of California to operate and maintain a pipe line across the Isthmus, and to furnish crude oil to the Isthmian Canal Commission and the Panama Railroad Company at 90 cents per barrel of 42 gallons; and also described the system by which the oil is delivered. On April 1, 1909, an amended contract went into effect providing for a price of $1.10 per barrel (delivered into storage tanks) for a term of six years and guaranteeing the use of not less than 30,000 barrels a month at this price. The oil company has since served notice that if more than 60,000 barrels, the maximum amount named in the contract, are used, a higher price will be charged. About 55,000 barrels are consumed each month at present, the oil being tapped direct from 42 storage tanks situated at convenient places along the line of the canal.

Since the publication of the first article tests have been made by the testing engineer of the Mechanical Division to find out what changes in the various plants using oil would increase the efficiency, and thus lower the cost. The lowest efficiency obtained was that in which 7.12 pounds of water were evaporated from and at 212° F., per pound of oil, and the highest, that in which one pound of oil evaporated 14.22 pounds of water. It has been found in most cases that oil at $1.10 per barrel is more economical than coal at $6.25 per ton, the cost of Pocahontas coal at all points on the Isthmus excepting Cristobal and Colon. The use of oil as fuel has been discontinued at the cold storage plant in Cristobal, because it is cheaper to use coal.

The following table shows the wide variation in economy of the boilers, due to the fact that their settings were designed orginally for coal burning and no very extensive changes were made when they were fitted for oil, because of the former uncertainty of the continued use of this fuel:

The tests were made as nearly as possible under normal working conditions, and the highest economy was obtained at Rio Grande, where all the air for combustion is pre-heated by passing through fire-brick passages below the flame. All the burners are of the steam spraying type, using steam at full boiler pressure and oil under a gravity head of from 30 to 100 feet.

Oil heaters have been installed recently in several of the plants and a gain in economy is expected. The upkeep cost of brickwork has been much higher than when coal was burned, and several new types of furnace, especially designed for oil burning, are under consideration and test at the present time. It is expected that a furnace giving both a high thermal efficiency and a low upkeep cost will be developed within a short time for the 84-inch by 18-foot horizontal fire tube boilers, of which there are thirty in service at Rio Grande, Empire, Las Cascadas, and Gorgona Shops.

FUEL OIL IN THE NAVY.

Secretary of the Navy, George Von L. Meyer. states in a letter to Senator Perkins of California that oil is used as fuel quite extensively on the vessels of the Navy more recently designed. In the case of the latest destroyers oil is the only fuel used, while in the later battle-ships both oil and coal are used under boilers.

This fuel oil is purchased by annual contract, and is advertised for, and bids submitted for in the usual way.

The battle-ships fitted for fuel oil carry about 400 tons each, and the torpedo-boat destroyers about 210 tons each. There are at present built and building, fifteen torpedo-boat destroyers and six battle-ships, using oil as fuel. To fill the oil tanks of these vessels would require about 6150 tons, and, of course, the amount of oil used would depend upon the rapidity with which the tank supply was exhausted.

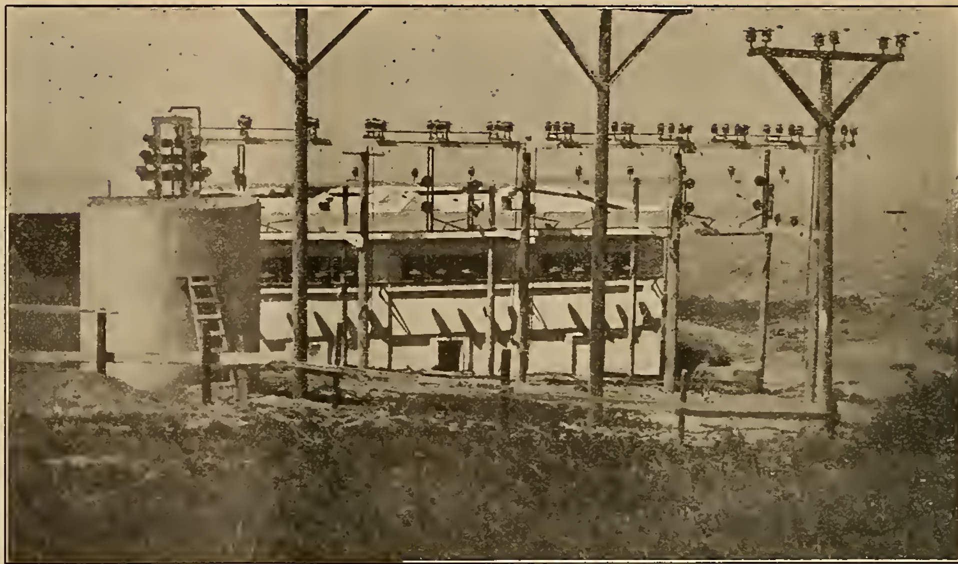
As to the probable extent of the use of oil as fuel in the future, of course, I am unable to state. At the same time all indications point to its continued use.

Examination for forest engineer is announced by the United States Civil Service Commission on July 27-28, 1910, to fill a vacancy in the position of forest engineer, $1800 per annum, in the Forest Service, and vacancies requiring similar qualifications as they may occur. The examination will consist of pure and applied mathematics, use and construction of instruments, and surveying, design and construction of highways, railroads, dams, retaining walls, foundation work, trusses, etc.

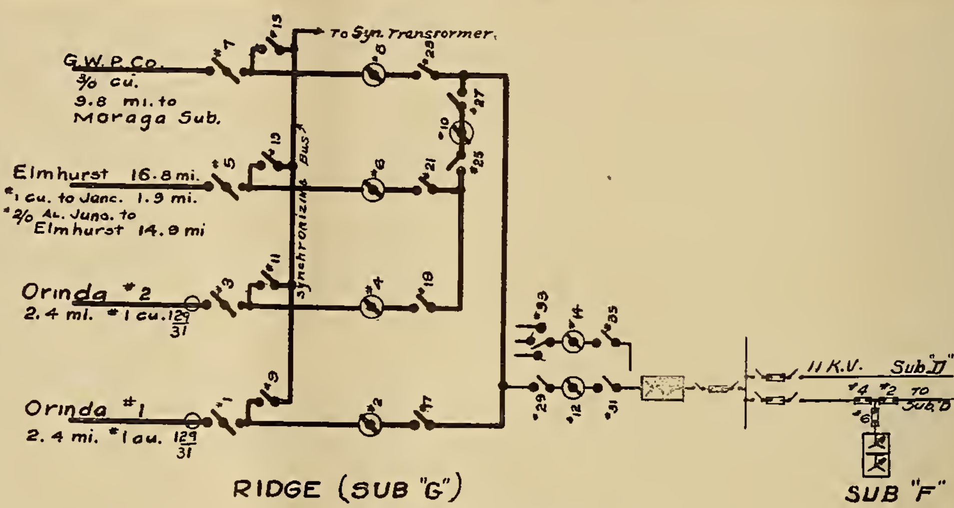
Location	Number and type of boilers.	Rated boiler horsepower generated during test. (Per cent.)	Efficiency of boilers (Per cent.)	Equivalent evaporation from and at 212° F. per lb. of fuel oil. (Lbs. water.)
Cristobal ice plant	6 Abendroth and Root water tube	118.	69.5	12.56
Mount Hope pumping station	2 Locomotive type	65.0	39.0	7.12
Gatun pumping station	2 Locomotive type	198.	61.6	11.23
Gatun power plant	6 Keeler water tube	95.	71.7	13.07
Gorgona pumping station	2 Scotch marine	170.	75.2	12.80
Gorgona shop power plant	6 Horizontal fire tube	79.	70.0	12.49
Las Cascadas air compressor plant	6 Horizontal fire tube	98.	74.1	13.28
Empire air compressor and power plant	12 Horizontal fire tube	101.	76.5	13.69
Rio Grande air compressor plant	6 Horizontal fire tube	90.	77.6	14.22
Ancon pumping station	3 Vertical fire tube	173.	68.5	12.50
Balboa power plant	5 Manning vertical fire tube	71.	63.3	11.75
Balboa power plant	2 Stirling water tube	115.	73.8	12.82

THE RIDGE SUBSTATION AT BERKELEY.

BY C. F. ADAMS



Air Switches at the North Berkeley Sub-Station.



High Tension Switching Diagram.

To permit the removal of the Pacific Gas & Electric Company's high-tension wires from the cities of Oakland and Berkeley, the Ridge Substation was constructed. It is east and south of the abandoned quarry of the Spring Construction Company, and is now the terminus of the 60,000-volt lines from South Tower and Elmhurst, and also of one of the branches of the Great Western Power Company. The low-tension feeders (11,000 volts) running from this station supply current to Berkeley and Oakland, and entirely replace the 60,000-volt lines which formerly passed through Berkeley and Oakland.

The station is constructed entirely of concrete, steel, and glass, and is designed to withstand any of the troubles and fire risks which are incident to high-tension switching stations.

Back of the station are located the air-break disconnecting switches, the concrete reservoir and water-cooling tower, and the 60,000-volt potential transformer, used for synchronizing purposes.

The air-break switches are of the standard, horizontal, double-blade, rotating type, the only new feature being the substitution of an angle-iron frame for the previous all-wood construction. Switch frames also support a line short-circuiting device, and a set of disconnecting switches attached to the synchronizing bus. The entire structure is clearly shown in the general view. Another picture gives a view also of the rear of the station, the 60,000-volt inlet windows, etc. The general arrangement of circuits leading to and from this station is shown on the high-tension switching diagram.

The building itself is divided into two main sections by a fire wall. The east section contains the 60,000-volt oil-switches and wiring. The west section contains the transformers, the 11,000-volt oil-switch compartments, and the switch-board and operating devices for the entire station.

Referring to the high-tension switches, some feature of their mounting are novel. The switch itself is of the horizontal two-break type, the contacts being immersed in a coil held in a wood-fibre container. The switch top is of Catalina marble. Each pole of the switch is mounted in a concrete cell having sheet-iron doors. The height of this cell places the conductors out of reach of the attendant. The cell is designed to resist extreme trouble conditions, and possible ignition of oil.

The oil tub rests on a metal shelf and it is removed for inspection by means of a small truck with a screw elevator. Each complete three-pole switch has its own concrete compartment, and the walls of these compartments support the single pole disconnecting switches used on each side of the oil-switches.

In the transformer room are located four 1500-kilowatt transformers, and space has been provided for six more when required.

The transformers are of the water-cooled type, the circulating water being propelled by a small, motor-driven, centrifugal pump. The water drains into a concrete sump, and thence it is elevated into the concrete reservoir and cooling tower. It is fed by gravity through the transformer cooling coils.

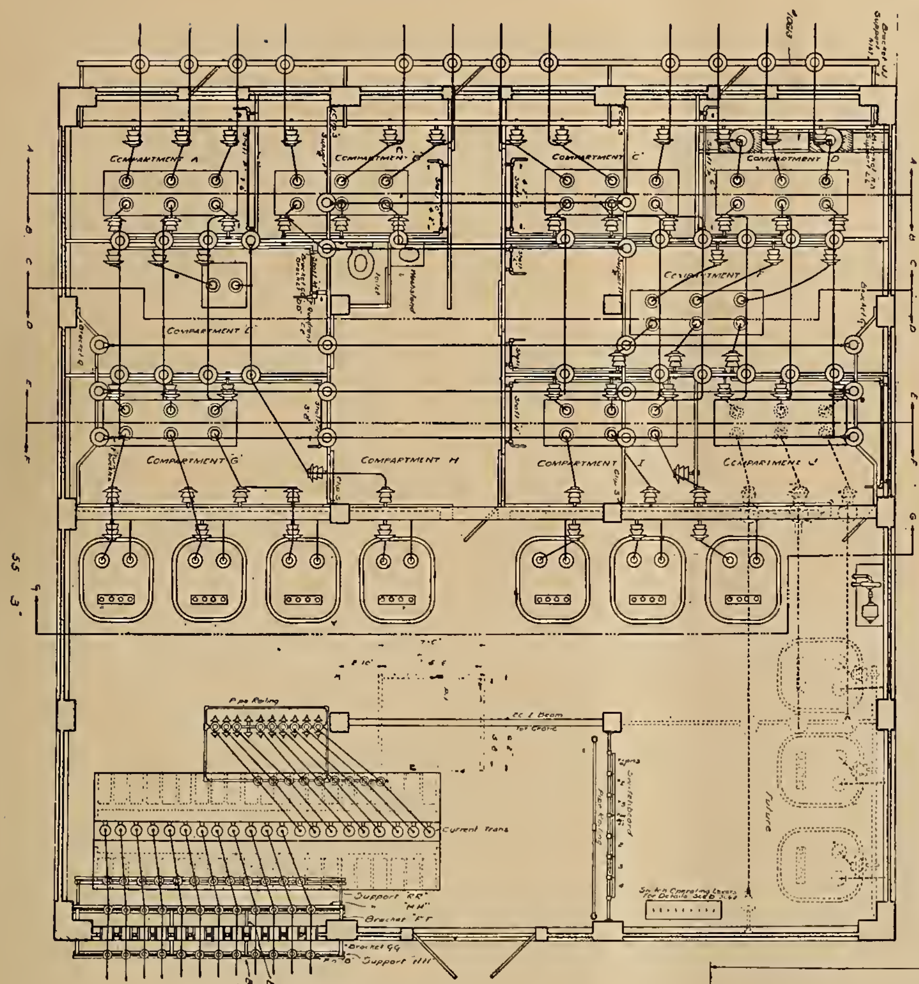
The 11,000-volt oil-switches are mounted in a reinforced concrete structure. These switches are the single pole, K-2 type of switch, manufactured by the General Electric Company, and each pole of the switch is enclosed in a separate compartment. The operating mechanism for the three switches is connected to a single operating shaft and released by a single trip.

The operating mechanism, disconnecting switches,

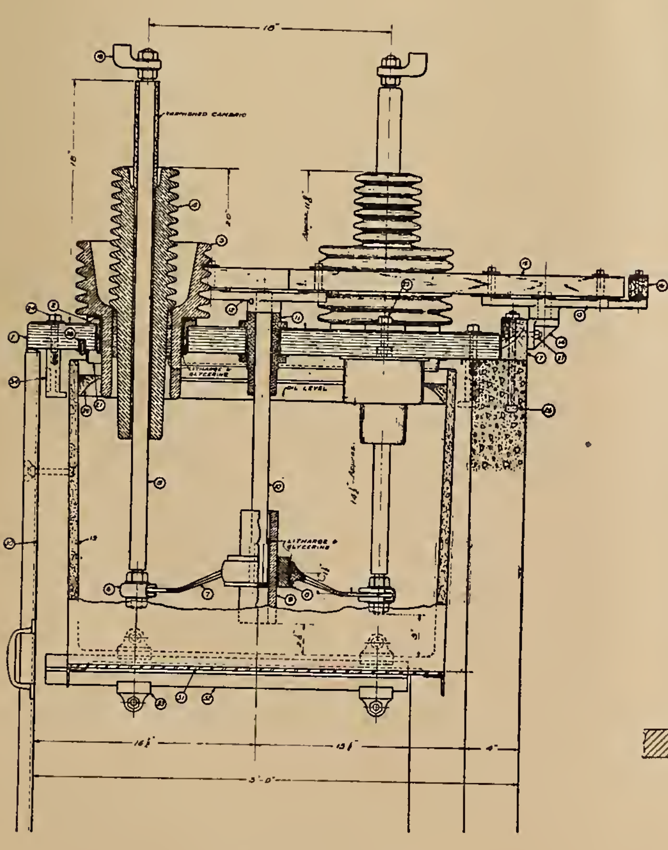
etc., were constructed at the Pacific Gas & Electric Co.'s Sacramento supply district. The switchboard is built of ebony asbestos wood, mounted on a pipe frame, and braced to the concrete walls and columns.

At the present time but two sets of 11,000-volt feeders are carried from this station. These feeders will be increased as the growth of business may require.

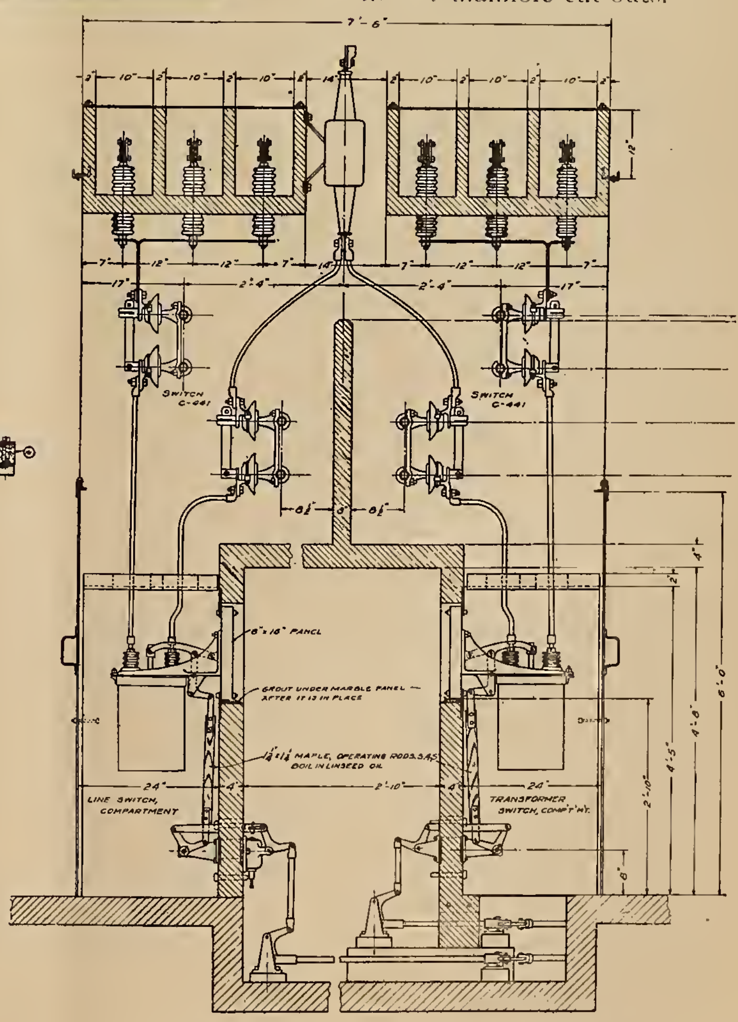
An automatic oil switch to take the place of line boxes on overhead 2400-volt distribution lines and to care for predetermined overloads is suggested by A. R. Cheyney in a paper read this week at the annual convention of the American Institute of Electrical Engineers. It would seem that it should be possible to manufacture such a device that would in a measure compete, even in cost, with the present enclosed fuses and line or manhole cut-outs.



Plan of Ridge Substation.



The 60,000-Volt Switch.



Cross-Section of the 11,000-Volt Switch Cells.

THE MORALS OF PINCHOT CONSERVATION.

BY RUSSELL L. DUNN.

The temporary withdrawal of blocks of the remaining public land from which some Federal bureau is to select in 40-acre subdivisions for permanent withdrawal the parcels which will then be described as "water-power sites" in the Pinchot patter, is intended in operation to provide the raw material for the establishment of a new economic function for the Federal government. It is proposed that the United States shall lease out and rent these permanently withdrawn-from-disposal parcels of public land to be used as "water-power sites," or, more exactly expressed, to be used as the situs of water-works adapted to, or contributing to, the manufacture and use of water power.

There is a question as to whether or not the Federal government possesses the delegated power to become a landlord in the several States. This, however, is a question of constitutional law and not a question of morals. It is not considered here. For the consideration of the question of morals it is assumed that the United States may become a landlord and rent out the public land instead of disposing of it.

The United States becoming a landlord must perforce adopt a business policy in fixing rental rates for the "water-power sites." Business has morals. The renting of "water-power sites" besides being business as common people understand business, is conservation as uncommon people patter about it. Gifford Pinchot says he is the father of conservation, and, freely adapting from the custom of the Russians which indicates the son of the father by prefixing the name of the father—thus Tzar, the father, and Tzarovitsch, the son of the Tzar—one may indicate this child of its father Pinchot, as Pinchot Conservation, from whence by correlation, as the Geological Survey would express it, the morals of the business of renting the "water-power sites" are the Morals of Pinchot Conservation.

Now there are possible two business policies between which choice may be elected by the United States as its landlord policy in fixing rental rates for "water-power sites." Either the landlord United States may make a flat uniform rental rate based on the area of United States land occupied as the situs of water-works, or, the landlord United States may make special rental rates for each renter based on the profit of his power-earning business without reference to the area of the United States land occupied as situs of water-works.

If the landlord United States were to fix a flat uniform rental rate per acre for the land occupied as situs of water-works, the policy of this would be consistent with the policy of the existing public land laws which provide for the disposal of the land at a flat uniform price per acre for each class of land. By this policy the more acres occupied by water-works the more rent, therefore there is a business reason for a classification of public land now which would select all land for permanent withdrawal which might at any future time by any plan of fabrication of water-works become the situs of any of them. It is a fact that with such a classification definition there would be selected for permanent withdrawal about all of the remaining public land in the Rocky Mountains and Pacific States which "water-power sites" to be rented by the acre means the has any disposal value for settlement. Thus, making permanent stopping of settlement. The question of morals involved with this policy for the business is not with the amount of the fixed acre rental charge, even though it be unconscionably high, but with the breach of the compact of the states. This compact, expressed in acts of admission of sovereign states to the Federal union of sovereign states, expressly providing that the states when admitted with their granted sovereignty should not interfere with the disposal of the public land by the United States, nor tax it pending disposal, implied that there was assumed an obligation by the United Staes to make a disposal of the public land which would cause its settlement. The renting out of the public land is not a disposal of it, and the renting out of it as "water-power sites" prevents its settlement.

But, the landlord United States would appear to have already made an election of the alternative business policy in fixing rental rates for "water-power sites." It is true that the United States has not formally adopted this alternative business policy by act of Congress. But Pinchot Conservation couldn't wait till Congress enacted, and didn't wait. Pinchot Conservation not only elected the alternative business policy for the United States, but by means of ways of official misdirection which it invented to eliminate Congress from the business put the policy in operation. The working condition created was and is the same as if Congress had enacted that the business policy of the United States in fixing rental rates for "water-power sites" would be to fix a special rate of rental for each renter based on the profit of his power manufacturing business without reference to the acreage of United States land occupied as situs of water-works.

By this policy it is very plain that more acres occupied as situs do not mean more rent. Therefore, there is no business reason for a classification of public lands now which will select all land for permanent withdrawal which might at any future time by any plan of fabrication of water-works become the situs of any of them. Practically, the power to fix and collect rent by this policy for "water-power sites" would be secured to the United States with no more United States land than the span's width of it which margins the flow of the waters of the rivers and lakes. Using the public land survey as the basis of selection to obviate the survey of the meanders of the banks of streams and lakes, the power of the United States to fix and collect rent from "water-power sites" would be secured by an act of Congress permanently reserving from disposal or withdrawing from disposal, all 40-acre subdivisions of the public land traversed by or bordering on a water course. There would be no business reason for withdrawals of the public land in blocks for subsequent examination and classification as "water-power sites" as the law could put the burden of proof that the land did not touch water on applicants to enter it.

Making "water-power sites" by permanently withdrawing only the 40-acre subdivisions "touching water," while it would permanently withdraw a large aggregate area of the remaining public land in the Rocky Mountain and Pacific Coast states which has any disposable value for settlement, would not with-

draw all of such land, and it would not stop settlement. The question of morals involved with the business policy under consideration is thus not concerned with this possible withdrawal of the minimum area of public land as "water-power sites." Being possible of accomplishment without the expenditure of public money, consuming nothing but the time and talk of Congress, there is no business in it, and hence no morals in it. But Pinchot Conservation has not elected this line of least economic resistance without morals. Pinchot Conservation has elected to take the chances of the morals and to make "water-power sites" its way by adopting the line of maximum economic resistance, the way which wastes the most public money in examinations and classifications, the way which permanently withdraws from disposal the maximum area of public land, the way which stops most settlement, and the way which breaches to the limit the compact of the Federal union with the several states. Pinchot Conservation thus lives consistent to its conception in a great moral insurgence. It wanted to have all the morals there were. It has all the morals there are.

The business principle at the basis of the policy which would fix a special rate of rental for each renter of a "water-power site" based on the profit of his water-power business is not a new discovery by Pinchot Conservation, although it is so represented by uncommon people who do not know the business of common people except from a looking glass. It is a pity the principle is not new. Really, it is as old as the time when cave men bought and sold stone axes. Pinchot Conservation has undertaken to employ it disguised in a new dress. As presented by Pinchot Conservation this ancient business principle is clothed by providing that an application to rent a "water-power site" from the landlord United States shall be accompanied by plans and specifications for the fabrication of the water-works proposed and also for water-works which would prospectively provide for the manufacture of all the possible quantity of water-power using the same situs of works; that a substantial entry fee shall be paid at the time of application and that a charge shall be made on the capital invested or upon the gross earnings, adjusted every ten years by a new appraisement; that the business shall be limited to earning for the applicant only a reasonable profit on his investment; and that at the end of his lease the landlord United States shall succeed to the business.

Taking the stitches out of the seams of this dress to get at the pattern from which it was cut, it appears that Pinchot Conservation proposes that the landlord United States shall take as rent for its "water-power sites" all of the net earning which the business gains by its margin between the operating cost of manufacturing of its water-power and the current selling price of any form of power in its market, except that portion of the net earning which would be its landlord definition of a "reasonable profit" on the renter's investment in the business. It cannot be assumed that the landlord United States would require of its tenant that it should sell its manufactured commodity, water-power, in one or other form, at less rates than the current selling rate for power in the market, in order that its tenant shall not make more than its definition of a reasonable profit on his investment. Therefore, it must be assumed that Pinchot Conservation proposes that the landlord United States shall keep the profit of the business to the tenant down to its definition of reasonable by taking as rent of "water-power sites" any excess of net earning over reasonable, whatever that is. So with its clothes off and their pattern found, the business principle of Pinchot Conservation is nothing but our old shop-worn familiar, "taking all the traffic will bear."

There is a question of morals involved with applying in these modern times the business principle of "taking all the traffic will bear." The question has been the subject of exceedingly serious discussion because of railroad corporations making application of the same principle in fixing freight rates. The same question of the morals involved has been the subject of even more serious discussion because of large manufacturing corporations, usually referred to inclusively as "the trusts" or "malefactors of great wealth," making application of the principle in fixing the prices of commodities which they sell.

The general conclusion of the discussion is that the morals involved in "taking all the traffic will bear" are scandalous. Our President voicing the public feeling over these morals has anathematized them in messages to Congress. Congress has enacted law with which the Courts may reduce the scandal by forcing the principle into "innocuous desuetude" in the practice of railway freight rate fixing by the railroad corporations and in the pricing for sale of commodities by the "malefactors of great wealth" who make them to be sold.

Yet, right in the midst of the discussion of the scandalous morals of the railroad corporations and the trusts caused by their employment of this business principle—right at the very time when Congress and the President have conducted it and its morals out of railroad corporations by the front door of the Capitol at Washington—Pinchot Conservation has been domiciling the same old business principle of "taking all the traffic will bear" with all its scandalous morals and some more as a permanent resident of the Capitol inducting it in by the back door of the White House. And one may be sure too that neither the President nor Congress have known that Pinchot Conservation was doing this while everybody was looking at it.

WESTINGHOUSE REPORT.

The annual report of the Westinghouse Electric and Manufacturing Company and its subsidiary manufacturing companies for the year ended March 31st, shows a net income of $3,060,644. From the preceding year's operations a deficit of $918,000 resulted so that an increase of $3,979,346 was represented in last year's net. Gross earnings of the company amounted to $29, 248,632, an increase of $8,642,090.

At the close of the fiscal year, March 31, the electric company alone had unfilled orders on its books amounting to $11,256,197. During April and May additional orders were booked aggregating $7,083,033. The total of unfilled orders on hand May 31, 1910, was more than $13,000,000. At but one time in the company's history has the unfilled volume been greater; this was on March 31, 1907, when $14,237,212 of orders were on hand.

THE WATTHOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

(Continued.)

CHAPTER VIII.

RATES.

The Edison Electric Illuminating Co., of Boston, Mass.

Lighting Rates—Commercial.

Electricity for any use will be sold, under the following schedule, to any customer who has signed an agreement for electric service, embodying the terms and conditions of the company.

A price of 12 cents per kilowatt-hour will be charged for all electricity furnished under this schedule, and the minimum charge will be $1.00 per month per meter.

Power Rates—Commercial.

Electricity for power use will be sold, under the following schedule, to any consumer who has signed an agreement for electric service, embodying the terms and conditions of the company. "Power" is defined as general motor service, cooking, heating, electroplating, charging storage batteries, and similar service, but does not include the runuing of dynamos for electric lighting purposes.

A price of 12 cents per kilowatt-hour will be charged for all electricity furnished uuder this schedule, with the following deductions, and the minimum charge will be $1.00 per month per meter:—

A price of 9 cents per kilowatt-hour will be charged for all electricity furnished in excess of 23 and not exceeding 103 hours' use of the *demand for each month.

*The demand is the greatest amount of electricity used by the customer at any one time. Until such time as the company installs one or more indicators, automatically to determine the demand, either in whole or in part, it may estimate the demand. The demand on any circuit, when an indicator is installed, will be the average of the regular monthly readings of the indicator, between October 1st and the following February 1st in each year. The demand so determined, beginning February 1st of each year, shall be the demand for the next twelve months, except that the demand in no case shall be less than 1/3 of the highest reading during the previous twelve months and in no case shall be less than one kilowatt; and provided that if any direct-connected elevator (as defined by the company) be installed the demand shall not be taken at less than 10 kilowatts. The customer has the privilege of having the indicator cut out one night in each month, provided a 48-hour written notice is given to the company.

A price of 6 cents per kilowatt-hour will be charged for all electricity furnished in excess of 103 hours' use of the demand for each month.

Whenever that portion of a customer's bill which is calculated at the 9-cent and 6-cent rate, or both, exceeds $10.00 per month, a discount of 70 per cent will be allowed on such excess over $10.00.

Whenever a customer's bill, after the foregoing deductions have been made, exceeds $100.00 per month, a discount of 30 per cent will be allowed on all in excess of $100.00.

Elevator Rates—Commercial.

Electricity for direct connected elevator use will be sold, under the following schedule, to any customer who has signed an agreement for electric service, embodying the terms and conditions of the company. A "direct-connected" elevator is defined as being an elevator running in guides, and in which the car starts at the same time as the motor.

A price of 12 cents per kilowatt-hour will be charged for all electricity furnished under this schedule, with the following deductions, and the minimum charge will be $1.00 per month per meter:—

A price of 5 cents per kilowatt-hour will be charged for all electricity furnished in excess of 300 kilowatt-hours and not exceeding 600 kilowatt-hours per month.

A price of 3 cents per kilowatt-hour will be charged for all electricity furnished in excess of 600 kilowatt-hours and not exceeding 4000 kilowatt-hours per month.

A price of 2½ cents per kilowatt-hour will be charged for all electricity furnished in excess of 4000 kilowatt-hours per month.

Yearly Lighting Rates—Commercial.

Electricity for any use will be sold, under the following schedule, to any customer who has signed an agreement for yearly electric service, embodying the terms and conditions of the company.

A price of $60.00 per year, payable in equal monthly installments will be charged per kilowatt of the *demand up to and including 15 kilowatts.

*The demand is the greatest amount of electricity used by the customer at any one time. Until such time as the company installs one or more indicators, automatically to determine the demand, either in whole or in part, it may estimate the demand, but in no case shall it be taken at less than 2/10 of a kilowatt. The demand on any circuit, when an indicator is installed, will be the greatest reading of the indicator between November 1st and the following February 1st of each year, and the demand so determined, beginning February 1st of each year, shall be the demand called for by the agreemnt for the next twelve months, except that the demand in no case shall be less than 1/3 of the highest reading during the previous twelve months. The customer has the privilege of having the indicator cut out one night in each month, provided a 48-hour written notice is given to the company.

A price of $36.00 per year, payable in equal monthly installments, will be charged per kilowatt of the demand for all kilowatts exceeding 15 and up to and including 55.

A price of $30.00 per year, payable in equal monthly installments, will be charged per kilowatt of the demand for all kilowatts exceeding 55.

These prices do not include the supply of electricity.

A price of 5 cents per kilowatt hour will be charged for all electricity furnished under this agreement up to and including 1500 kilowatt-hours per month.

A price of 3 cents per kilowatt-hour will be charged for all electricity furnished under this agreement exceeding 1500 kilowatt-hours and up to and including 5500 kilowatt-hours per month.

A price of 2½ cents per kilowatt-hour will be charged for all electricity furnished under this agreement exceeding 5500 kilowatt-hours per month.

Permanent Electric Rates.

Electricity for any use in specified premises will be sold, under the following schedule, to any customer who has signed an agreement for at least 50 kilowatts of permanent electric service, embodying the terms and conditions of the company.

A price of $60.00 per year, payable in equal monthly installments, will be charged per kilowatt of service up to and including 15 kilowatts.

A price of $36.00 per year, payable in equal monthly installments, will be charged per kilowatt of service for all kilowatts exceeding 15 and up to and including 55.

A price of $30.00 per year, payable in equal monthly installments, will be charged per kilowatt of service for all kilowatts exceeding 55.

These prices do not include the supply of electricity.

A price of 5 cents per kilowatt-hour will be charged for all electricity furnished under this agreement up to and including 1500 kilowatt-hours per month.

A price of 3 cents per kilowatt-hour will be charged for all electricity furnished under this agreement exceeding 1500 kilowatt-hours and up to and including 5500 kilowatt-hours per month.

A price of 1½ cents per kilowatt-hour will be charged for all electricity furnished under this agreement exceeding 5500 kilowatt-hours and up to and including 105,500 kilowatt-hours per month.

A price of 1¼ cents per kilowatt-hour will be charged for all electricity furnished under this agreement exceeding 105,500 kilowatt-hours per month.

The company will deliver its electricity at the customer's premises, and, in consideration of not supplying lamps and

care, will deduct from the net amount of the bill, as otherwise rendered, ½ cent per kilowatt-hour.

The company will provide capacity for intermittent overloads up to 40 per cent in excess of the kilowatts applied for by the customer.

An excess price of 20 cents per kilowatt hour will be charged for all electricity furnished at any time in excess of the kilowatts applied for by the customer.

Terms and Conditions.

For the purpose of determining the amount of electricity used, a meter shall be installed by the company upon the customer's premises at a point most convenient for the company's service, upon the reading of which meter all bills shall be calculated. If more than one meter is installed, unless for the company's convenience, each meter shall be considered by itself in calculating the amount of the bill. When more than one meter or discount indicator is installed under this agreement, for the company's convenience, the sums of the consumptions and demands shall, in all cases, be taken as the total consumption and demand.

All bills shall be due and payable upon presentation and shall be rendered monthly, unless either the customer or the company desires bills rendered weekly, in which case it may be done by adjusting to a weekly basis all the monthly figures referred to in the schedule of rates.

A minimum charge will be made of $1.00 per month per meter, unless otherwise provided.

The customer will be responsible for all charges for electricity furnished under this agreement until the end of the term thereof and for such further time as he may continue to take the service; except that where the customer has the right to terminate the agreement by notice, which shall be in writing, he shall remain liable for all charges for ten days thereafter.

The customer will be responsible for all damage to, or loss of, the company's property located upon his premises unless occasioned by the company's negligence.

The company shall not be responsible for any failure to supply electricity, or for interruption or reversal of the supply, if such failure, interruption or reversal is without default or neglect on its part.

The company reserves the right to install a circuit breaker, so arranged as to disconnect the service in the premises, if the company's capacity at that point is exceeded.

If a customer, who is not paying a rate calling for an annual fixed cost, desires to use the electric service as auxiliary to another source of power (excluding, however, small sources of power not exceeding two horsepower) he may do so only by paying a minimum charge of $3.00 per month per kilowatt for as many kilowatts as it is possible for him to use on the service at any one time; this number to be determined by a circuit breaker, so arranged as to disconnect the service if the number of kilowatts is exceeded.

It is agreed that all lamps, plugs, meters and such other appliances as are furnished by the company shall remain its property. And it is further agreed that all wiring upon the premises of the customer, to which the company's service is to be connected, shall be so installed that the company may carry out this contract, and shall be kept in proper condition by the customer.

Permission is given the Company to enter the customer's premises, at all times, for the purpose of inspecting and keeping in repair or removing any or all of its apparatus used in connection with the supply of electricity, and for said purpose the customer hereby authorizes and requests his landlord, if any, to permit said company to enter said premises.

The benefits and obligations of this contract shall inure to and be binding upon the successors and assigns, survivors and executors or administrators (as the case may be) of the original parties hereto, respectively, for the full term of this contract.

(To be continued.)

Delegates at Railway Telegraph Association Meeting.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The twenty-ninth annual convention of the Association of Railway Telegraph Superintendents was held in Los Angeles from June 20th to 26th. The visitors were welcomed to Los Angeles by the Hon. George Alexander, Mayor, and Mr. Joseph Scott, president of the Chamber of Commerce. Mr. Scott's invitatoin to partake of the fruits of Southern California was substantiated by each visitor finding a large basket of luscious Californian fruits awaiting him in his apartments.

The various papers presented before the meeting were on pertinent subjects, some of which will subseqcently be reproduced in these columns. One of the most interesting meetings was that of Thursday evening, when the local members of the American Institute of Electrical Engineers attended. The subject, "High Tension Crossings,' was one of considerable interest and the discussion was ably led by Messrs. Miller, Scattergood, and other members. The use of telephones for train dispatching was thoroughly presented by many members.

It was a fitting tribute that the greatly appreciated services of Mr. I. T. Dyer were rewarded by electing him to the presidency of the association for the ensuing year. The other officers elected were: J. B. Sheldon, Union Pacific, Omaha, first vice-president; William Bennett, Chicago and Northwestern, Chicago, second vice-president; P. W. Drew, Minneapolis, St. Paul and Sault Ste. Marie, re-elected secretary-treasurer.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS
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604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
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Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Killing the Goose

A nicety which forbids bull fighting and ostracises prize fighting permits the popular pastime of baiting public service corporations. Like a practical joke, it hurts not only those attacked but also reacts on the perpetrators, for all community prosperity is closely interwoven with those enterprises whose magnitude and risk require capital for their inception and development. Public ownership and operation of public utilities is theoretically ideal. When a municipality has the initiative to install an electric plant and the political purity to run it economically the citizens are the gainers in receiving such service at the cost price. But it usually requires some farsighted business man with the courage of his convictions to risk the money necessary to make these public improvements. It also requires careful management to make the venture a dividend payer, a care which is not necessary in a municipal plant which can collect taxes to pay deficits or depends on municipal bonds for extensions. We hold no brief for the private corporation, but regard this matter merely in the light of the self-interest and self-preservation of the community's prosperity.

What is it that gives value to outlying real estate if it is not rapid transportation, convenient telephone service and proper lighting? Quick transit allows us to enjoy the comforts of a suburban home; the telephone enables us to do twice the business in half the time, the electric light is a better protector than policeman and doubles the hours for business or pleasure. Withdraw them and the property is good only for a cow pasture. Yet, if the present campaign of vilification and persecution be not stopped the corporations will be obliged to surrender their holdings to the tender mercies of the petty grafters who seek easy berths in municipal plants. There are too many tempting investment propositions for capital to long linger where it is not appreciated.

Even when not driven to the extreme of abandonment a corporation thus treated has but little incentive to improve or extend its service. On the other hand an approving public sentiment fosters developments such as have heretofore been made in Spokane and Los Angeles whose street railway systems are the admiration of the world as contrasted with the dilapidated outfit that is a direct result of the late San Francisco administration's custom of hampering legitimate development. The inevitable result of such destructive agitation will first be felt in the Eastern bond markets where investors will fear to trust their savings to the caprice of local rate regulators or to the violence of striking carmen. By undermining the confidence upon which we are dependent for the needed capital to develop the West, these self same agitators are insidiously attacking the country in which they live and as such are not desirable citizens.

PERSONALS.

G. I. Kinney, Pacific Coast manager for the Sprague Electric Company, is spending a week at the Los Angeles office.

J. P. Downs, the Pacific Telephone & Telegraph Company's general superintendent of traffic, is in Honolulu on a vacation trip.

Leon M. Hall, consulting engineer for the Comstock mines, has gone to Virginia City, and expects to celebrate the Fourth of July in Reno.

G. B. Bush, general commercial superintendent of the Pacific Telephone & Telegraph Company, is in the Pacific Northwest on an inspection tour.

Sidney Sprout, electrical engineer, is making a week's tour of Southern California, visiting Los Angeles and the Burrell power station in the Kern river canyon.

C. O. G. Miller, president of the Pacific Lighting Corporation, has gone to Santa Barbara and will spend a month in Southern California, automobiling with his family.

Leon Vanatta, a recent Stanford graduate who has been with the Northwestern Pacific railroad, is now with the Pacific Electric & Manufacturing Company of San Francisco.

Paul Shoup, assistant general manager of the Southern Pacific Company, in charge of all the electric railway lines, has returned to San Francisco from a trip to Los Angeles.

H. A. Culloden, who had been acting auditor of the Pacific Electric Railway Company, has been elected secretary and auditor of that company with headquarters at Los Angeles.

Charles F. Mason, commercial engineer of the Pacific Telephone & Telegraph Company, attended the recent convention of railway telegraph superintendents at Los Angeles.

H. D. Donnell, assitant engineer of the Safety Car Heating and Lighting Company has taken office room with Sidney Sprout and A. C. Sprout at 922 Crocker Building, San Francisco.

H. B. Woodill of Los Angeles has been elected president of the Long Beach Electrical Manufacturing Company. J. N. Nighton will soon take charge of the sales department of the same company.

The newly elected executive committee, Los Angeles Section, A. I. E. E., for year 1910-1911, is E. K. Davis, I. T. Dyer, J. A. Lighthipe, J. E. Macdonald, R. H. Manahan, E. K. Northmore, E. F. Scattergood.

M. M. O'Shaughnessy has returned from San Diego, after inspecting the operations at the Morena dam, which he is constructing in the mountains for the Southern California Mountain Water Company of San Diego.

C. S. Sedgewick, who was connected with the commercial department of the Pacific Gas & Electric Company during the past year, recently went to Dixon, Cal., as manager of the Solano District, which now extends down the peninsula from Davisville.

G. R. Field, assistant general manager of the Great Western Power Company, has returned from a trip to the hydroelectric plant at Big Bend, where the construction of the big dam is progressing satisfactorily. The water in the river has reached a stage low enough to permit of more rapid work.

S. G. McMeen and H. A. Lardner have been elected to fill two-year terms on the executive committee of the San Francisco Section, A. I. E. E. and W. A. Hillebrand, a one-year term, the remaining members being C. W. Burkett and S. J. Lisberger. Mr. Hillebrand is the delegate to the national convention.

W. A. Widenmann has been made manager of the Stanislaus District which was recently created by the Pacific Gas & Electric Company, with headquarters at Newman. The electric distributing system of the Newman Light & Power Company was recently purchased by the company and an extension of fourteen miles from the Patterson ranch will give connection with the main transmission lines.

H. F. Jackson, assistant general manager of the Sierra & San Francisco Power Company; H. W. Crozier of Sanderson & Porter, and George J. Henry Jr. and W. D. Ward of the Pelton Water Wheel Company recently inspected the Sierra & San Francisco Power Company's hydroelectric plant whose four generators are being reconstructed so as to increase their normal rating to 8700 kw. each. A parallel transmission tower line is also being built, to be completed in September, at a cost of $500,000.

TRADE NOTES.

N. M. Goldthwaite is now San Francisco agent for the U. S. Electrical Manufacturing Company of Los Angeles.

The General Electric Company has sold to the Alaska-Treadwell Gold Mining Company a 250-h.p., 2200-volt, 720-r.p.m. motor for use at the mines.

The Oakland Traction Company has purchased ten General Electric 2.16 (50 h.p.) two-motor car equipments for use on the street railway lines in Oakland.

The Smith-Booth-Usher Company of Los Angeles have installed a 10x10 triplex Gould single-acting pump with a 20-h.p. electric motor at Whittier City water plant and are pumping at present 300 gallons a minute.

Henry C. Hyde recently succeeded W. A. Ekberg as representative of the Peerless Electric Company, Willard Storage Battery Company, Hart Manufacturing Company, Hartford Time Switch Company, Frank Adam Electric Company, Condit Electric Manufacturing Company, and Enamelled Metals Company at 143 Second Street, San Francisco.

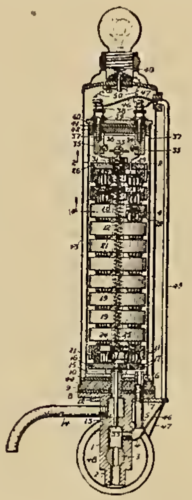
The Charles L. Kiewert Company of San Francisco have arranged with the Union Eng. Co., 225 Franklin Court, Los Angeles, to act as their agents in the southern territory for the Kiewert Lighting Specialties, including Aurola and Alba flaming arcs and Siemens carbons for enclosed arcs, flaming arcs and moving pictures. They are preparing to establish agencies in all important cities on the coast.

Recent orders and shipments of the Pacific Electric & Manufacturing Company of San Francisco include six thirty thousand volt switches to Dawson, Y. T., three sixty thousand volt switches to the Pacific Coast Power Company, Seattle, Wash.; 24 twenty-two thousand oil disconnecting switches to the Sacramento sub-station of the Great Western Power Company, six high voltage switches to Deadwood, S. D., and two new type suspension insulator switches for the one hundred thousand volt line of the San Francisco & Sierra Power Company at Mission San Jose.

F. G. Sykes, president of the American Power & Light Company of New York, announced in Spokane that negotiations have been completed for the purchase of electric, gas, water and street railway plants in eleven cities in southeastern Washington and northern Oregon and Idaho. Properties will be operated by the Pacific Power & Light Company, capitalized for $7,500,000 and incorporated by the first named concern at Pasco, Kennewick, Sunnyside, Mabton, Wapato, North Yakima, Walla Walla, Lewiston, Pendleton, Adams, Freewater, and Astoria, Ore. The company will also own and operate steam-generating plants at Astoria, Walla Walla and Kennewick, a water-power plant on the Walla Walla river and combined steam and water-power plants at North Yakima and on the Natchez river, ten miles above North Yakima. Mr. Sykes said the chief purpose in getting into the Inland Empire is to furnish power for irrigation plants in the Columbia river, Yakima and Walla Walla valleys.

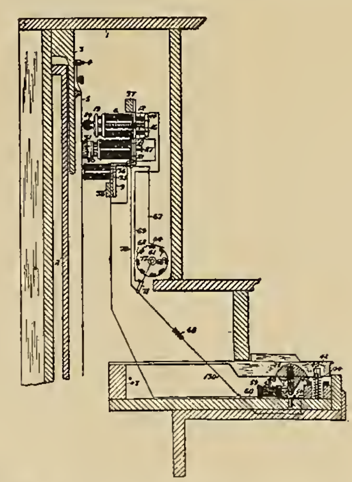
PATENTS

961,937. Electric Water-Heater. William F. Cutler, San Francisco, Cal., assignor to Cutler National Electric Heater Company, San Francisco, Cal. The combination of a heating chamber, a vertical series of inverted cup-shaped insulators therein, each apertured to permit the liquid to freely circulate therethrough; coils in said insulators, electric conductors



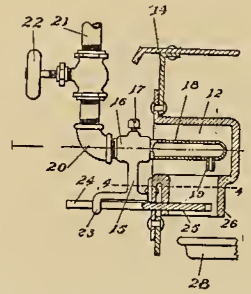
leading to said coils, a discharge pipe for conducting the liquid from said heating chamber, means for admitting the liquid at the opposite end of the heating chamber to that from which said discharge pipe conducts, and an auxiliary supply pipe discharging into said heating chamber at the same end as that from which the discharge pipe conducts.

962,261. Electrical Piano. Robert A. Rose and George C. Holbrook, Santa Rosa, Cal. The combination, with strings, of hammers having parts attached thereto, solenoids arranged at right angles to said strings and immediately behind the hammers, frames carrying said solenoids, and provided with



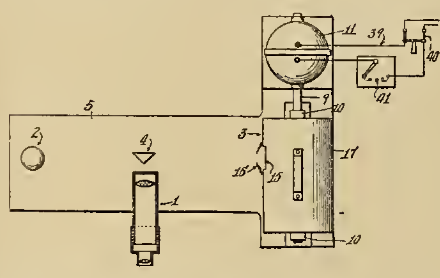
means for guiding the hammers to and from the strings and in a direction at right angles thereto, cores in said solenoids detached from the hammers, said solenoids being arranged to attract said cores to cause them to impinge upon said parts attached to the hammers, and propel the hammers against the strings, and springs for withdrawing the cores.

962,212. Oil-Burner. Henry R. Green, Spokane, Wash. A burner comprising a casting having an air chamber therein in communication with the atmosphere, an air discharge tube leading from said chamber at right angles to the communication with the atmosphere, a receptacle disposed beneath said air discharge tube, a bracket fixed to said casting, an oil feed nozzle extending within said air chamber and having a dis-



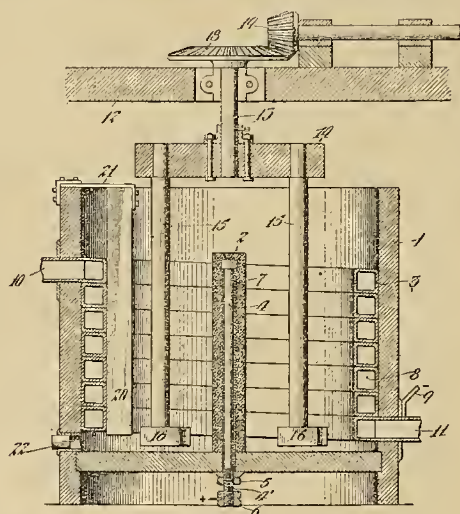
charge tube in alinement with the air discharge tube, a guide eye formed on said bracket, and a cut-off slide working in said eye and adapted to open and close said air discharge tube.

961,852. Universal Photometer. Tamaki Fujita, Los Angeles, Cal. In a photometric apparatus, means for producing rays of light of different color, intercepting means for cutting



off a variable portion of the light of each color, and means for directing said rays onto a comparator to blend the effects of the differently colored rays of light for production of the effect of a composite light for the purpose stated.

962,040. Apparatus for Electrical Treatment of Ores. William B. McPherson, Los Angeles, Cal., assignor of one-half to Gail Borden, Los Angeles, Cal. An apparatus for electrical

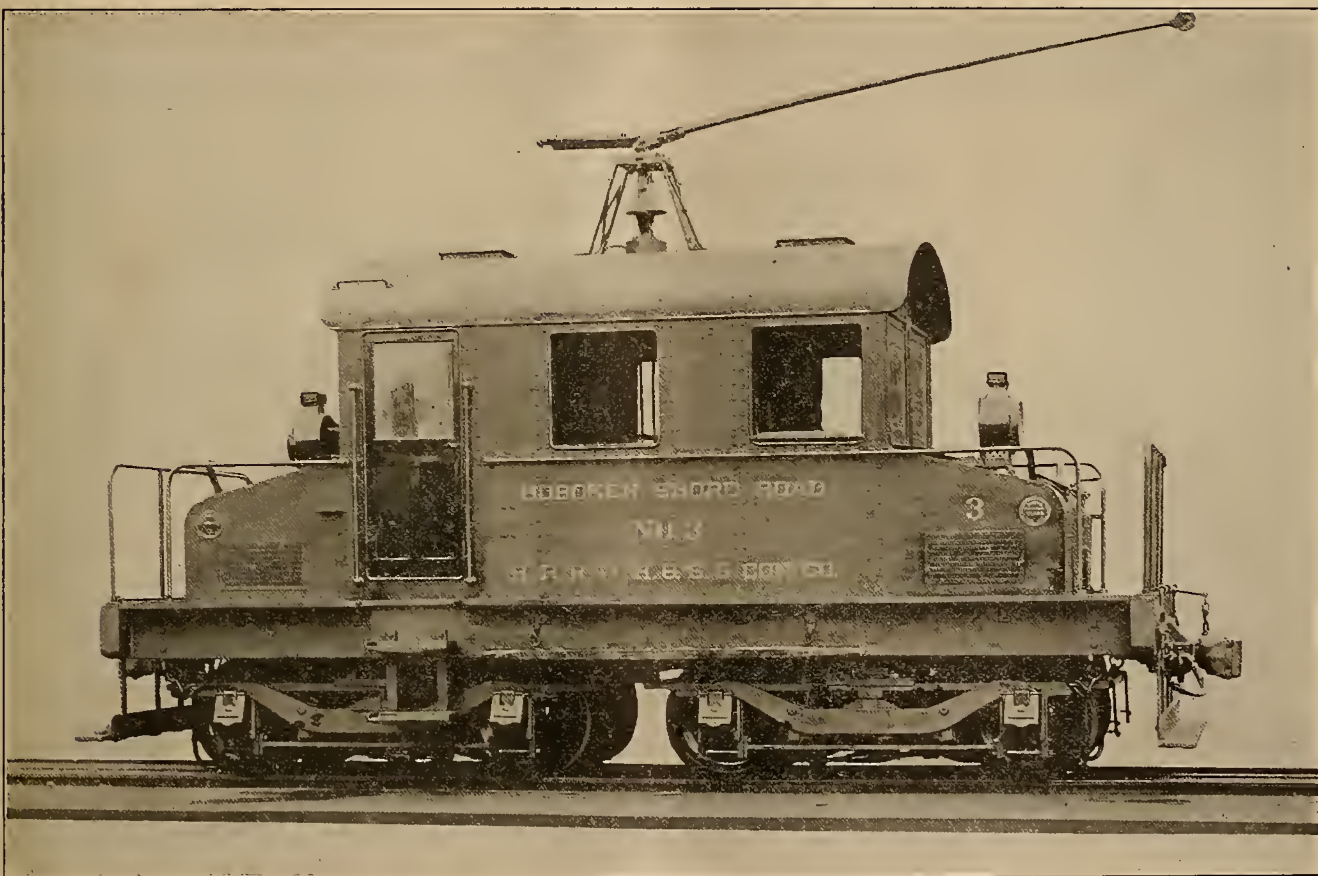


treatment of ores comprising a central electrode therein, an outer electrode concentric with the central electrode, said outer electrode being hollow and provided with means for passing heating medium therethrough.

INDUSTRIAL

ELECTRIC SWITCHING LOCOMOTIVE EXCITES FAVORABLE COMMENT.

The Hoboken Railroad, Warehouse & Steamship Company has had in operation since May, 1906, a sixty-ton electric switching locomotive whose remarkably continuous and economical performance under varying and severe load conditions has caused many very favorable comments in railroad circles. This locomotive has not only supplied the demand made most urgently by operating men that the service be perfectly reliable, but has been operated continuously at a maintenance cost that is exceedingly low.



A Sixty-ton Electric Switching Locomotive.

Since the electric locomotive was placed in operation four years ago there has not been replaced a single contact on the switch group or a contact on the master switches or reverser. On the control apparatus nothing other than two tips on the live switch has been replaced. The brushes that are in the motors at the present time have been operating fourteen months, and the master mechanic believes they will operate at least six months longer without replacement. No trouble has been experienced with broken brushes. Except that there has been replaced one pinion which was broken when a lock washer dropped into the gears, no repairs on the motor have been necessary.

The cost of inspection and cleaning has been practically nothing. Every Saturday morning the man operating the locomotive makes an inspection of the equipment. With compressed air he blows out the motor and the various parts of the control apparatus, and cleans any part that may need it with a piece of cloth. This work is not charged to maintenance, as the operator in doing it is simply filling in his time. No extra time is needed for maintenance or inspection.

The locomotive has a running and a starting drawbar pull of 14,500 pounds and 30,000 lbs., respectively, and has a normal speed of 12 miles an hour. It has four 100 h.p. slow speed motors; a hand operated unit switch control, and Westinghouse air brakes with a D-4 compressor. The electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; the mechanical parts, the steel cab and the trucks were built by the Baldwin Locomotive Works. The Hoboken Company stated that there never has been a time when the locomotive refused to work or would not do the work required of it. It averages twelve hours a day of shunting service very nicely every day in the year.

NEW CATALOGUES.

Bulletin No. 1070 from the Allis-Chalmers Company is devoted to "Barometric Condensers, Type B."

Ohio Valves and Steam Specialties are attractively listed in Catalogue H from The Ohio Brass Company of Mansfield, Ohio.

Bulletin No. 11 from the engineering department of the National Electric Lamp Association covers the description, performance and economy of the "Mazda" street series lamp.

"Type C Jet Condensers" are illustrated and described in Bulletin No. 1071 from the Allis-Chalmers Company. With this type vacuum can be formed or recovered with full load on engine or turbine, without stop valve in main exhaust pipe or auxiliary forced injection.

DRUM TYPE CONTROLLERS FOR MACHINE TOOLS.

For the control of machine tools driven by electric motors where the starting service is frequent or of a severe nature, drum type controllers should be used in preference to other types. The General Electric machine tool controllers shown in their book of information on industrial control devices, have been designed with many special features to meet the conditions of modern shop practice. Among these features may be mentioned substantial removable barriers between the fingers wherever required; magnetic blow-outs for all equipments for 500-volt service or for large currents at lower voltages; special screws to hold the segments with heads slightly countersunk below the surface so as to prevent their wearing with the segments, and tapered at such an angle as to prevent their loosening; sheet iron covers lined with asbestos to protect live parts from dust and mechanical injury, and eliminate danger of shock from accidental contact; terminals and other parts readily accessible; and field control with adjustable fingers similar in design to the fingers for the armature circuit.

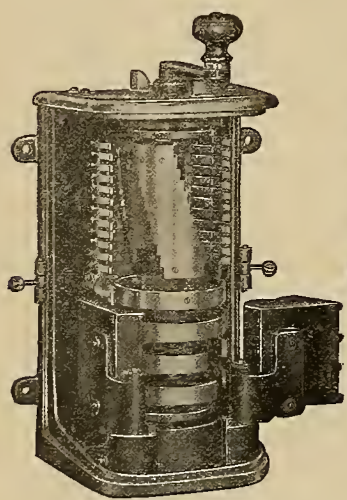


Fig. 1. R-99A Controller.

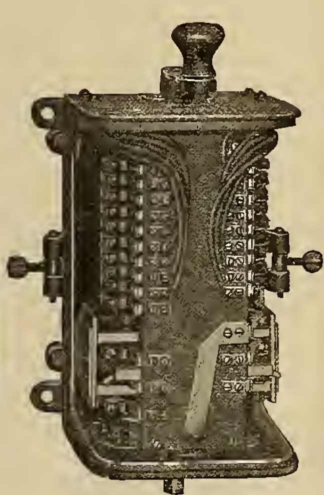


Fig. 2. R-116-A Controller.

When it is desired to obtain overload and no voltage protection in connection with drum controllers, a CR-251 panel should be used. This panel consists of a DP circuit breaker, a single pole contactor and two fuses, all mounted on a slate base, the latter being provided with feet to make a neat installation. The circuit breaker and fuses afford the overload, and the contactor the no voltage protection. The operation of these panels depends essentially upon an electrical interlock between the no voltage release and the drum controller. When the controller handle is moved to the first point the coil of the contactor is energized, closing the contactor and completing the armature circuit. As greater force is required to close the contactor than to hold it closed, when the controller handle is moved beyond the first point, a high resistance is inserted in series with the contactor coil to prevent the contactor from closing in case of a restoration of voltage after failure, until the controller is turned back to the first point. This device is designed for both shunt and compound wound motors.

In Bulletin No. 4744, issued by the General Electric Company, is described a meter testing rheostat, which by means of switches forming a part of the device, may be made to give loads varying from one-half an ampere to the full load rating of the rheostat in one-half ampere steps. The rheostat is made in two sizes: one of 15 ampere and the other of 30 ampere capacity, weighing 7 and 14 pounds, respectively.

TRAIN DISPATCHING EQUIPMENT.

The extensive exhibit of telephone train dispatching apparatus by the Kellogg Switchboard & Supply Company at the Los Angeles convention of Railway Superintendents of Telegraph, June 20-26th, demonstrated to what limit this feature has been developed. To those who are more or less interested in telephony this display was indeed a surprise, and even to those who have been personally concerned in this branch of communication the perfection and completeness of Kellogg apparatus was distinctly noticeable.

The exhibit room was the point of interest for all delegates and visitors from the opening time until the close, and in addition to much valuable information gained by the visitors the Kellogg company had the satisfaction of securing several substantial orders for apparatus after the various makes had been compared.

The Wray-Cummings and the Gill selectors were both exhibited, as either type is supplied, this being a point to be settled entirely by the user. One of the most interesting items was a section of a Kellogg transmitter, the vital point of all telephone equipment. The non-packing and non-deteriorating qualities of this transmitter were clearly shown and many personal testimonials were received from actual users all the way from Mexico to Canada. The new steel mouth piece with a perfect insulation to protect the telephone user from foreign currents drew many favorable remarks.

Kellogg Exhibit at Meeting of Railway Telegraph Superintendents.

Various types of portable telephones for train use were displayed. The large type containing hand generator, ringer, and micro-telephone set, all encased in a heavy steel case, to prevent breakage by careless train crews, was especially noted on account of its indestructibility, and the micro-telephone set with small battery equipment, all mounted in a leather carrying case was commented upon for its compactness and lightness.

The waiting-room set, high-tension insulated set, and non-breakable portable desk set were exclusive features, and the head band receiver with a swivel joint in the band to admit of its use as a hand telephone attracted more than usual attention. The jointed pole for connecting trains to the dispatcher's circuit was also shown. Composite telephones, for operation on the same circuit with telegraph instruments, were in actual operation.

The entire exhibit was made up from the stock room of the Kellogg Company in San Francisco, showing the completeness of this stock, and demonstrating the advisability of all coast companies using a type of equipment which they can secure at short notice.

NEWS NOTES

INCORPORATIONS.

YUMA, ARIZ.—The Yuma Gas Company has been incorporated by W. Jay Fair, C. J. Lynch and others with a capital stock of $1,000,000.

GARFIELD, WASH.—The Garfield Town and Rural Telephone Company has been incorporated by W. B. Harris, J. A. Dix, F. M. Scott and others.

OLYMPIA, WASH.—The consolidated Printing Telephone Company has been incorporated by G. Mackay, C. E. Collier. B. A. Barr, T. B. Rae, J. H. Kugler, G. T. Parker and J. B. Bancus, with a capital stock of $25,000.

TRANSMISSION.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company has started preliminary work for its proposed power plant on the Grand Ronde river.

CENTRALIA, WASH.—The Twin City Light & Traction Company has let the contract for a $150,000 power plant to be located on Coal creek about four miles southeast of here.

BELEN, NEW MEX.—A petition has been presented by M. W. Flournoy of Albuquerque, asking the Board of Commissioners to grant him a franchise for electric power plants at Belen.

REDDING, CAL.—The Inskip power plant of the Northern California Power Company has started up, adding 8000 h.p. to the electrical output of the company and making its total 27,000 h. p., itemized as follows: Volta power house, 9000; Kilarc, 4000; South power house, 6000; Inskip, 8000. Inskip is on South Battle Creek, in Tehama county, one mile from the Shasta line.

SEATTLE, WASH.—Plans have been announced by the Vancouver Power Company, a subsidiary organization of the British Columbia Electric Railway Company, which contemplates the development of 100,000 horsepower of electric energy. The source of power is located in Chilliwack lake and Jones lake, both lying in the Chilliwack district. To fully develop the two sources of power the British Columbia Electric Railway Company will expend $10,000,000.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company has sent a party of engineers to the Grand Ronde to commence the surveys preparatory to the installation of a power station. The company has acquired title to the power site and all necessary holdings and has made extensive engineering investigations relative to the character of the formation, the power ditch and matters pertaining to the construction work. The construction of the Grand Ronde power plant is one of the first matters to receive the attention of the new interests, as the present power plants are inadequate to supply the demand for power, and the water used in the operation of the Asotin Creek plant is needed for the Clarkston Heights irrigation district.

SAN ANDREAS, CAL.—The Sierra Nevada Water Company, which for a number of years was endeavoring to develop a part of the water-power of the Mokelumne river at a point between Railroad Flat and West Point, and actually commenced operations on a large scale, will shortly resume under a new organization. Aside from purchasing ditches and established water rights, the company, through its men in the field, located everything which it believed might prove of future value. A large basin suitable for reservoir purposes was purchased and construction work on a dam below the Licking fork commenced. Thousands of dollars were expended when the financial stringency following the fire struck the company hard and it was unable to meet its obligations. It also became involved in considerable litigation. Frank Z. Towle had been general manager for the company, also being interested financially. With the other creditors he failed to get any money for his services, and finally all claims were assigned to Milton Bernard, who obtained a judgment for $12,202.77. A transfer was made to the company, and Towle, who had also further protected himself by relocating lapsed water rights, included these, all for the purpose of clearing title and settling the financial end through an amicable understanding. The situation at the present time is such that the company intends to immediately resume operations and complete its power plant.

TRANSPORTATION.

LOS CRUCES, NEW MEX.—The City Council has passed an ordinance granting to Isidoro Armigo and S. T. Reynolds, a franchise to construct an electric street railway in this city.

MARTINEZ, CAL.—A. W. Maltby, vice-president of the Antioch and Oakland Electric Railroad has applied for a franchise to operate trains on the county roads between Martinez and Pacheco.

SEBASTOPOL, CAL.—The matter of granting a franchise to John E. Bennett for an electric line from the power house in Sebastopol to the town limits was taken up, and an ordinance passed granting the franchise.

RIVERSIDE, CAL.—The Council has instructed the City Attorney to draw up an ordinance relinquishing the Crescent Railway Company's franchise from all unused portions of the road over which the franchise extended.

SAN FRANCISCO, CAL.—Announcement is made by the United Railroads of a change in the operation of the Haight street owl line. The new schedule calls for a half-hourly service on the Haight street owl line, instead of hourly, as heretofore.

SAN BERNARDINO, CAL.—It has been announced that the Santa Fe is to install automatic block signals on the double track between Cottonwood and Daggett, a distance of 22 miles. An electric plant will be installed at Barstow to furnish power.

LOS ANGELES, CAL.—An electric railway to the top of the Montecito Hills is to be constructed by the Mutual Home Building Corporation which recently bought of the Montecito Improvement Company 200 acres in the northeast corner of the original city of Los Angeles.

OAKLAND, CAL.—The Oakland and Antioch Railway has filed a trust deed to the Anglo-California Trust Company, covering all the property of the corporation, to secure an issue of $2,000,000 worth of 30-year 5-per cent bonds. The city filed for record the release of the Stockton street railway franchise recently executed by Frank J. Stringham and his associates in the contemplated railway line.

OAKLAND, CAL.—Following the severe criticism cast upon the Oakland Traction Company by the State Railroad Commission and by the coroner's jury, which investigated the death of five persons caused by the car wreck on the California Railroad on Memorial Day, the traction company is laying a double track line and installing sidings along the right of way leading to Leona Heights. The track-laying is being rapidly pushed from the main line at East 14th street to the Boulevard, a distance of about a mile and a

PROFESSIONAL DIRECTORY

half, and the siding is being put in at Talcott Station. The work, according to the engineers of the traction company, is being done in conformity with the Interstate Commerce Commission rules, under which the California Railroad is operated.

SAN JOSE, CAL.—That no railroad construction work will be begun by the Peninsular Railway Company this summer is the statement of F. E. Chapin, general manager of that company. He says: "The report that the company is about to begin work 'closing up the gap' between Palo Alto and San Mateo is absolutely unfounded. I cannot say when work will be commenced on that line, for I do not know. It is certain, however, that it will not be this summer. We are just as anxious to extend our lines as the people are to have us extend them, and as soon as the company can see its way clear to expend the million dollars necessary to close up that little gap, it will be done. We have acquired rights-of-way over about two-thirds of the distance, but have done nothing further."

ILLUMINATION.

LOS ANGELES, CAL.—One of the improvements to be made in Central Park is to be the lighting with ornamental electroliers, seventy-two of which are to follow the course of the walks.

LOS ANGELES, CAL.—The Domestic Gas Company has been awarded a franchise by the Board of Supervisors to lay gas pipe lines over many miles of country roads in the Glendale district.

LONG BEACH, CAL.—A franchise for a conduit system for the Edison conduit which is to connect the Edison plant with the ocean was sold by the Council to the Southern California Edison Company for the sum of $200.

LONG BEACH, CAL.—T. J. Corbrey of Chicago has obtained control of the Long Beach Electrical Company, by purchasing the interest of W. H. Tidmarsh, inventor of an electrical fuse. Mr. Corbrey states that the factory will be enlarged.

LOS ANGELES, CAL.—The Huntington Beach City Trustees have asked the city attorney to take preliminary steps for calling an election to decide whether a bond issue of $40,000 shall be made for the establishment of a municipal gas plant.

CHICO, CAL.—The Pacific Gas & Electric Company, already the owner of an extensive and valuable plant in Chico, has plans under consideration for the expenditure of over $50,000 in the extension and enlargement of its gas service in Chico and suburbs.

LOS ANGELES, CAL.—The Board of Public Works has awarded the contract for 188 ornamental electroliers at a cost of $15,463 to the Llewellyn Iron Works. These poles have been paid for by the residents and property owners of Pico street from Main to Vermont avenue.

OAKLAND, CAL.—The changing of the S. P. Company's motive power on its local steam roads to electricity was assured when the City Council granted the corporation permission to electricize its Webster street Alameda mole line. The work is to be begun as soon as practicable. A provision was adopted calling for the lighting of the thoroughfare in a maner similar to the lights to be installed by the company on its new line from Fourteenth street to the bay.

LONG BEACH, CAL.—The merger of the Inner Harbor and Edison Gas Companies is now an accomplished fact. The deal, which has been pending for six months, has been worked through to a successful end by D. J. Macpherson of Pasadena, consulting engineer and one of the directors of the Inner Harbor Gas Company. The Edison people were willing to meet its competitor fairly, and it was decided that the values of the two properties and their ratio of business should each be ascertained separately and the mean ratio thus established, which should form the basis of negotiations, and this resulted in a merger of the two properties on the basis of 63 per cent for the Edison plant, franchises and business, and 37 per cent for the Inner Harbor holdings. A corporation is to be organized under the laws of the State of California to be known as Long Beach Consolidated Gas Company with an authorized capital stock of $1,500,000, of which $500,000 par value shall be 6 per cent accumulative, participating preferred stock and $1,000,000 par value common stock, the new company to take appropriate proceedings authorizing the creation of a bonded indebtedness in the sum of $1,000,000; the new company to acquire from the Southern California Edison Company its gas plant, properties, gas system and gas business within the city of Long Beach free from incumbrances, paying therefor $165,000 par value of said bonds; $85,000 par value of said preferred stock, and $425,000 par value of said common stock of the new company; the remainder of the stock and bonds of the new company to remain in the treasury of the new company.

TELEPHONE AND TELEGRAPH.

COLVILLE, WASH.—John S. Diedrich has been granted a twenty-five year telephone franchise on road No. 4, etc.

WINCHESTER, WASH.—The farmers of this section have formed a telephone company and will build considerable line.

LEWISTON, IDAHO.—The Pacific Telephone & Telegraph Company will make outside improvements and extensions to its system in Lewiston and Clarkston to the amount of $26,000.

SPOKANE, WASH.—The Pacific Telephone & Telegraph Company will spend $700,000 in improving its system in Spokane and vicinity. Thirty per cent of the amount will be spent locally.

LEWISTON, IDAHO.—The Webb Ridge Telephone Company recently organized by J. A. Ferris et al., will construct a rural line 25 miles long from Sweetwater into the Craig Mountain country. Work will proceed at once.

SPOKANE, WASH.—The Medical Lake Telephone Company has been granted a franchise to construct local lines at Medical Lake. The Star Telephone Company has been granted a franchise to operate a system at Ochlare, a new town on the Inland Empire system about two miles south of here.

SAN FRANCISCO, CAL.—In presenting his amended report on telephone rates, providing for the retention of the cheaper party-line service eliminated in the first draft of the ordinance, Chairman Laughrey of the Supervisors submitted a report from Engineer C. L. Cory, showing that the Pacific Telephone & Telegraph Company will suffer a loss of $92,185 per year in its revenue in the event that all the switches allowed under the ordinance are used by the subscribers. Secretary Bush of the Pacific company, asked to present his views of the ordinance, said that the company had desired certain changes made, but if the board could not see the wisdom of allowing them, the company would endeavor to abide its decisions, and live up to the terms of the ordinance. Supervisor Bancroft said he thought the ordinance fair to the company and fair to the city. He had been a member of the former water-rates committee, which fixed the preceding rates, at which time the Pacific Telephone & Telegraph Company had complained, just as now, that it would lose money under the schedules, but that it had, on the contrary, made money. He predicted that the same result would obtain from the present ordinance. Without further discussion, the ordinance was passed to print.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 2 | SAN FRANCISCO, JULY 9, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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VOLUME XXV | SAN FRANCISCO, JULY 9, 1910. | NUMBER 2

STOCKTON GAS AND ELECTRIC COMPANY'S NEW SWITCHBOARD

BY L. A. SOMERS.

Among other improvements instituted by the Stockton Gas & Electric Company, of Stockton, Cal., during the past twelve months, may be mentioned the installation of one of the most modern and up-to-date switchboards, that has yet been furnished for central station practice on the Pacific Coast.

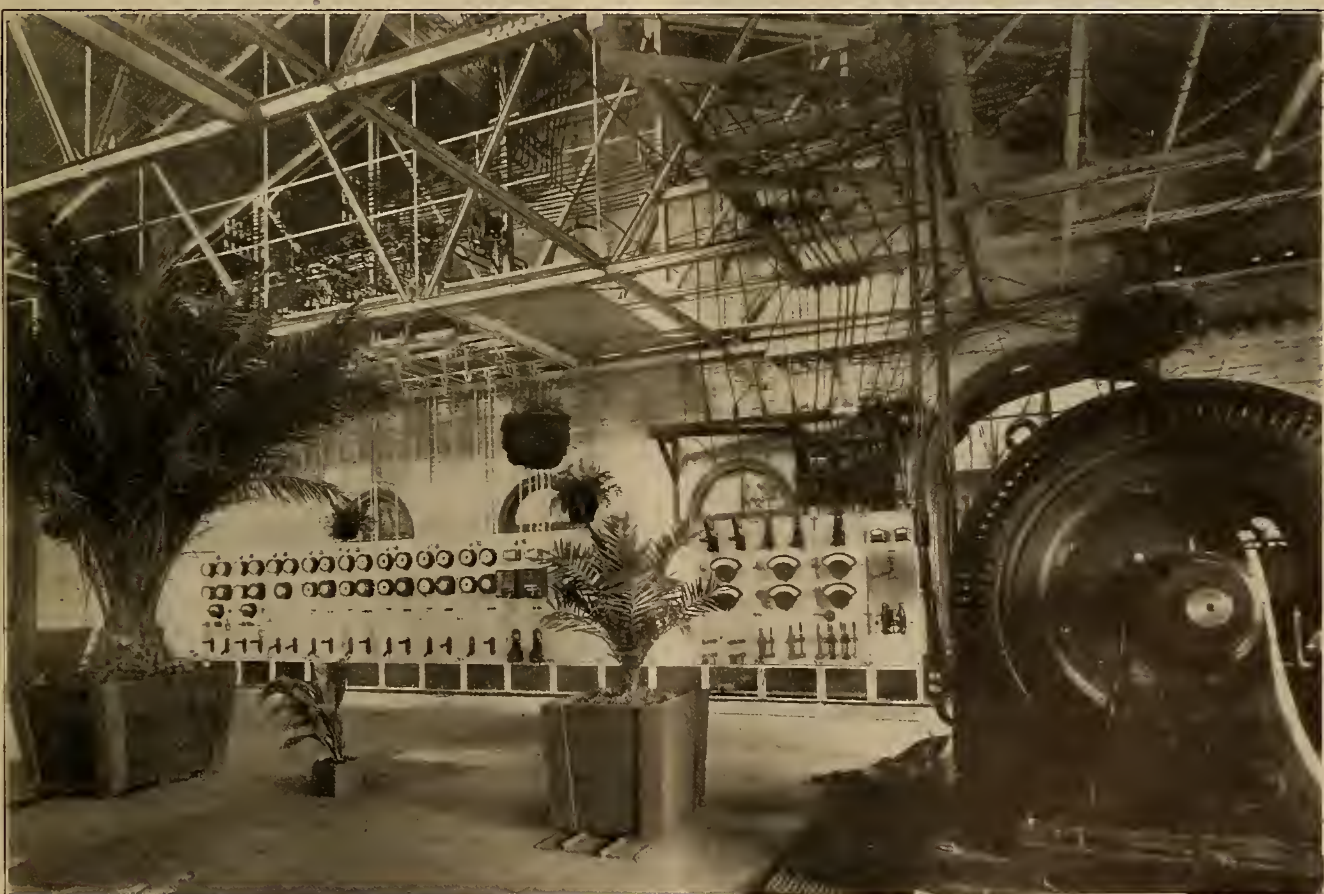


Fig. 1. General View Interior of Stockton Gas and Electric Co.'s Station. Showing Switchboard.

This board is arranged for the control of both alternating current and direct current circuits, and was designed by W. F. Lamme, consulting engineer of the San Francisco office of the Westinghouse Electric & Manufacturing Company, to meet the requirements of the Stockton Gas & Electric Company.

This switchboard is of the double bus bar type and all high tension switches are of the remote control type. As a result, the highest voltage that an operator can come in contact with on the switchboard itself on the alternating current panels is 110 volts.

If it should become necessary to examine or repair a high tension switch, this can be done quite easily and without any danger whatsoever to the attendant, as the board is built on the double bus bar plan and every oil switch is in duplicate.

These high tension oil switches are mounted over-head, directly above the switchboard. As stated above, the high tension switches are in duplicate. In front of each set of switches is arranged an iron gallery. When one set of switches is opened for inspection or repairs, it is absolutely impossible for the

switchboard attendant to come in contact with the other set of live switches.

This feature was introduced on the suggestion of Victor Etienne, formerly managing director of the Stockton Gas & Electric Company, and much credit is due the management of this company in requiring that the board be made as safe as possible, to the end that no loss of life or accidents might occur to the operator.

A rather novel feature may be mentioned in connection with the method of installing the graphic recording wattmeters, shown on Panel No. 8. These instruments are so arranged that by means of a special auxiliary bus-bar system, they can be plugged in for testing on any circuit on the alternating current side of the switchboard.

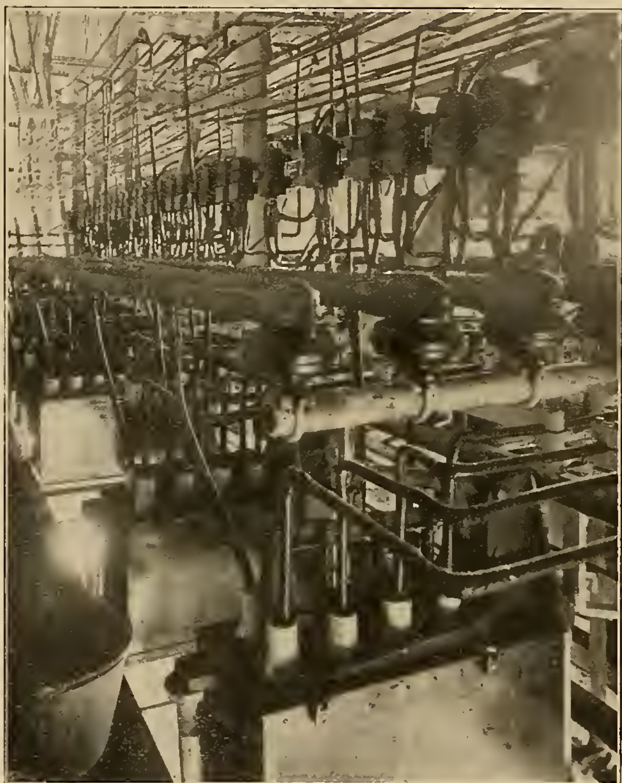


Fig 2. Overhead Gallery Showing Roomy Arrangement of Circuits, Series Transformers and Bus Bars.

A new conception in the equipment of central stations may be noted by referring to Fig. 1, where two handsome palms are shown directly in front of the switchboard. This idea is due to the artistic taste of Henry Adams, general manager of the Stockton Gas & Electric Company, who has supplied these beautiful plants as well as a number of ferns and hanging baskets, which may also be seen in the photograph. The board was erected by the employees of the Stockton Gas & Electric Company, and the marble, framework and the over-head iron work were also furnished by that company.

A detailed description of the board, panel by panel, is as follows:

Panel No. 1 controls the 400kw. Westinghouse motor generator set, shown in the foreground in Fig. 1.

Panels No. 2, No. 3 and No. 4, are the direct current panels, controlling the direct current circuits which supply the railway service of the Stockton Electric Railroad Company. These panels are equipped with Westinghouse type "E" illuminated dial voltmeters and ammeters.

Panel No. 5, is a blank panel for future extension.

Panel No. 6 controls the incoming circuit from the American River Electric Company's lines.

Panel No. 7, controls the incoming circuit from The Pacific Gas & Electric Company's transmission line.

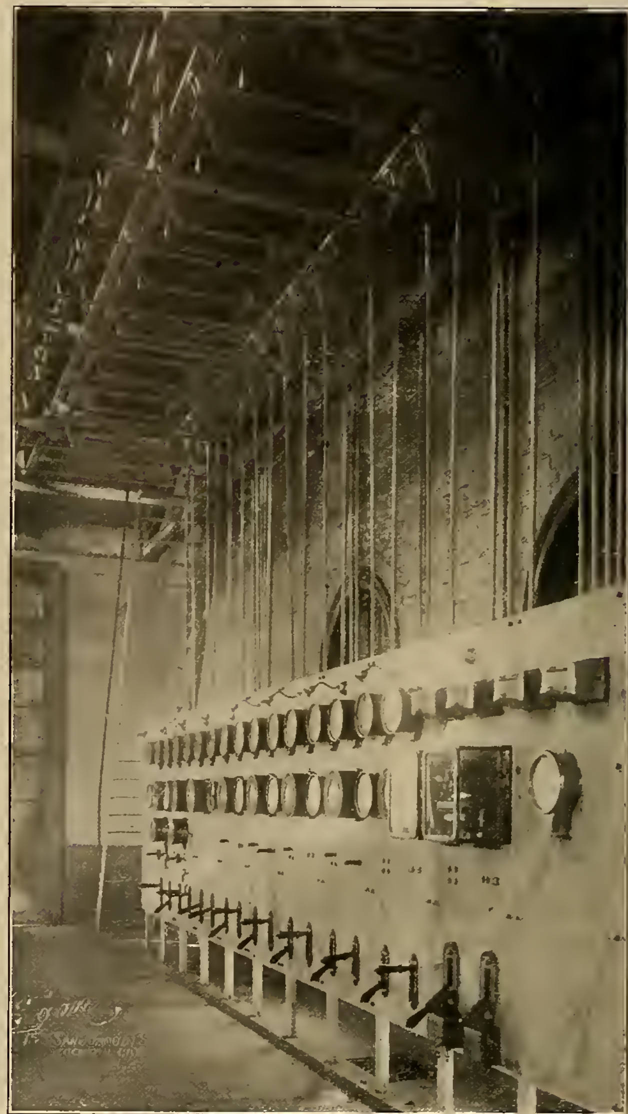


Fig. 3. Control Rods and Levers Giving Remote Mechanical Control.

Panel No. 8 is known as the main bus-bar panel, and has mounted on it, two Westinghouse Graphic Recording Wattmeters; two type "B" four pole, single throw oil switches; two type "F" voltmeters.

Panel No. 9, controls the three phase feeder panel, which serves as a power feeder for all three phase power furnished by this company.

Panel No. 10 is a two phase power feeder panel has mounted thereon the following instruments:

- 2 four pole, single throw type "F" circuit breakers.
- 2 type "F" ammeters.
- 1 type "F" polyphase indicating wattmeter.
- 1 type "C" polyphase integrating wattmeter.
- 1 lamp bracket.

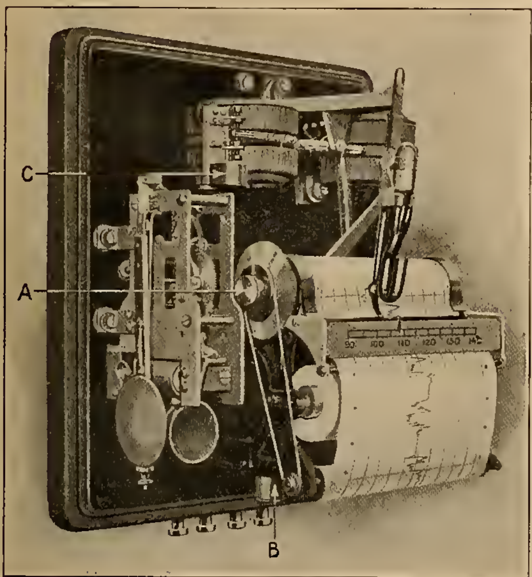
Panel No. 11 is also a two-phase power feeder panel, and has mounted thereon the following instruments:

2 four pole, single throw type "F" circuit breakers.
2 type "F" ammeters.
1 type "F" polyphase indicating wattmeter.
1 type "C" polyphase integrating wattmeter.
1 lamp bracket.

Panel No. 12 is a two-phase lighting feeder panel, and has mounted thereon:

2 four pole, single throw type "F" circuit breakers.
2 type "F" ammeters.
1 type "F" polyphase indicating wattmeter.
1 type "C" polyphase integrating wattmeter.

Panel No. 13 is also a two-phase lighting feeder panel, and is equipped with the same number and style of instruments as Panel No. 12.



Graphic Recording Wattmeter.

Panel No. 14 controls the two-phase arc lighting circuit, and has mounted thereon the following instruments:

2 four pole single throw type "D" oil switches, remote control type.
1 type "C" integrating polyphase wattmeter.

Panels No. 15 and No. 16 are for the control of motor generator sets No. 1 and No. 2. Each of these panels has mounted thereon:

2 four-pole, single-throw type "D" oil switches, breakers.
2 type "F" ammeters.
1 type "F" indicating wattmeter.
1 type "C" integrating polyphase wattmeter.
1 lamp bracket.
1 type "E" direct current ammeter.
1 type "D" field switch.

Panel No. 17 is a blank panel for future extension.

The above panels are composed of seventeen marble slabs, of blue Vermont marble, each slab being 72 by 30 by 2 in. and mounted 25 in. from the floor.

When facing the switchboard, the above panels are numbered from one (1) to seventeen (17) reading from right to left.

POSSIBLE IMPROVEMENTS IN STEAM POWER PLANT ECONOMY.

Discussion before the San Francisco Section, American Institute of Electrical Engineers, of paper by L. R. Jorgensen as published in the Journal of Electricity, Power and Gas of June 25, 1910.

Question: Is there any plant in operation where they have that second superheater?

L. R. Jorgensen: The installation of a second superheater in the flues leading to the smokestack has, as far as I know, not been proposed before. The low temperature of the steam (probably about 212 degrees) exhausted from the engine makes possible a transfer of heat from the flue gases to the steam, heat which otherwise would go to waste.

The combination of a reciprocating engine and a low pressure turbines is not new and a large number of similar installations are in existence. On board a ship this kind of installation should work well, too, and especially where artificial draft is used. A high temperature of the flue gases for creating draft would then be unnecessary. This is an expensive way to get draft anyway. However, with the new Melville Macalpine gear very likely a high speed turbine alone would make the best installation on a ship, and the second superheater should then be connected between the high pressure and low pressure portion of turbine.

S. G. Gassaway: I should think such a superheater would have to have a very large area of pipes.

L. R. Jorgensen: How large the second superheater would be depends upon the difference in temperature between the exhaust steam and the flue gases. If a high boiler pressure is used the temperature of the flue gases will also be high. The superheater could be installed below the floor, and could be made of sheet metal the same as the flue for the reason that this device would not be called upon to stand any pressure. It would be altogether different from an economizer in that respect.

George W. Dickie: Mr. Chairman, I did not come here to talk tonight. I came here to learn something. This matter of the economical use of steam is an important factor in all steam installations. It is unsatisfactory that we can only utilize such a small percentage of the heat that we get from the fuel. We have been told tonight of the difficulty with the turbine, and with the reciprocating engine, and how engineers have been trying to take away the troublesome end, which is at the beginning with the turbine and at the end with the reciprocating engine, from both in order to be able to use the steam most economically.

I was thinking while the paper was being read of a patent that was taken out in 1886 by a man in London named Leonard Jennet Todd, for an engine that he called the central exhaust engine. Very little was done with it because he evidently did not know just what he had really done; but in the last two years or so this engine has been taken up by a German professor, J. Stumpf, and out of it has been evolved what is now called the uni-directional flow engine. It is creating considerable comment in Europe. I saw a notice that one prominent firm was obtaining from it a most remarkable result, a steam consumption of 8.8 pounds of steam per hour, and as the engine is much simpler than either our reciprocating engine or the turbine, I am sure that, if what is claimed for it be true, it will in time take a very prominent place among prime movers.

In the horizontal type of this engine, the live steam is admitted from below into the cover, serves to jacket the latter, and finally enters the cylinder through the valve. At the completion of the working stroke it is exhausted through ports or slots which are provided in the middle of the length of the cylinder and which are uncovered by the piston as it completes its stroke. The direction of the flow of the steam is, therefore, never reversed. In the ordinary engine, on the contrary, the flow of the steam is alternating; that is, steam enters at the head of the cylinder and follows the piston while doing its work and at the end of the stroke the flow is reversed and it has to run back through an

exhaust valve at the point where it entered. This reversal of the steam flow leads to a cooling of the ports of the cylinder by the wet steam and consequently there is an increased condensation in the cylinder during the next cycle. It is claimed that the unidirectional flow avoids this cooling and resulting condensation in the cylinder and does away with the necessity of compounding These engines may, therefore, be designed for one stage doing all the expansion in one cylinder and giving an economy equal to the multiple expansion engine. The exhaust port being the whole circumference of the cylinder and opening directly to the condenser, the pressures in the condenser and the cylinders immediately equalize when the piston uncovers the port; on the return stroke any uncondensed vapor in the cylinder is entrapped and compressed in most cases to near the initial pressure. In the middle the cylinder has a temperature near to that of the condenser while at the ends the temperature is near to that of the entering steam which in these engines is usually superheated and that condition will be constant.

I think there is something worth studying in this especially for possible use here in California where the simplicity of this engine should make it attractive on account of the high cost of local labor. I can hardly believe the economy claimed, but it is certainly worth looking into for you who are so much interested in power plants and their economic working.

A. H. Halloran: To the operating engineer the most interesting part of this paper is the suggested economy of the boiler, or rather the economy in combustion. As the author brought out in his paper, a low pressure steam turbine can be added to a reciprocating engine, and improve its present efficiency. This is a matter for the manufacturer; but the efficiency of combustion is something that can be improved by every fireman. Mr. Jorgensen has shown that from 90 to 95 per cent of the energy in coal is wasted. One-third of this goes up the chimney as smoke. One-half of it is lost in exhaust steam. It seems to me that if our engineers and also legislators devoted as much time to improving the economy of existing power sources as they now expend in attempting to withdraw water-power sites or coal and oil lands, they would do more for our posterity and incidentally for ourselves, because our posterity will blame us far more for our wasteful use of power than they will praise us for our conserving disuse.

This matter of waste in the furnace is usually under-estimated. If the owner of a steam-power plant had to pay for his air as he does for his water he would soon caution his fireman to be careful. As Mr. Jorgensen has shown, using an excess of 200 per cent air means a loss of efficiency of 12.9 per cent greater than when 50 per cent excess air is used, this 50 per cent being recognized as good practice.

There are three ways of determining this excess air. You can use an air meter to measure the volume of air entering, and knowing the theoretical amount of air necessary to burn the coal it is easy to estimate what excess is being used. Or you can use a pyrometer to determine the temperature of the furnace gases as compared with the theoretical, to see if you are using too great an excess of air; but the usual method is this method of flue-gas analysis which Mr. Jorgensen has brought out.

An analysis of flue gas shows it consists of carbon monoxide, carbon dioxide and nitrogen, with some water. Mr. Jorgensen's remarks have been devoted largely to coal; and he makes the statement that the efficiency of burning oil is greater because there is not likely to be such a great air excess; but judging from reports that I have on some of the San Francisco plants there is certainly great room for improvement. Most of them are burning 300 per cent air right along. After this excess has once been determined by an expert, all that is necessary is for the fireman to put in one of those indicating CO_2 instruments mentioned by Mr. Jorgensen, and regulate his dampers in accordance with the readings. By connecting the indicator to the damper it is automatically adjusted as the load increases, for with greater load they need more air and coal. These facts seem simple and elementary; but if they can be brought before the fireman, the one who is responsible for the economy of the plant, the efficiency of every one of our local plants would be increased, as Mr. Jorgensen has shown, fully one-eighth, and this matter, while really of small moment, is worthy of discussion. I believe that the local members of the National Association of Stationary Engineers are somewhat interested. I am surprised there are not more of them here, and it would come before that more logically than before our body. The matter of the steam turbine is of course one that requires the services of a manufacturer's designer, and one that does not come within the province of the ordinary fireman.

A Member: I believe this is a matter that the section could very well afford to take up, inasmuch as any time you look around town from any point of vantage you will see a continual cloud of smoke coming out of almost every chimney. That smoke is not only a waste; it is a detriment to the health of the city, and causes a great deal of damage, and in every way you look at it it is a thing that should be eliminated, because it is quite possible to eliminate it. I believe it would be an advantage if the section were to take some action on the subject to bring it before the city authorities, or to get the other engineering bodies to take some action to see if it cannot be cut down somehow.

L. R. Jorgensen: I would like to say a few words about the CO_2 indicator. Some makes automatically trap off at regular intervals a constant volume, say 100 cubic centimeters, from a continuous stream of gas taken from the last pass. This trapped off portion of gas is brought into contact with caustic potash, which absorbs the CO_2, and a record is then automatically produced on a chart showing the amount of CO_2 in the sample of gas. If a boiler is working 12 hours a day the potash must be changed every 20 days. The Great Western Power Company in their Oakland steam plant uses a non-automatic CO_2 indicator. In this there are less parts to get out of order.

Thereupon the meeting adjourned.

WIRELESS IN GERMAN FISHERIES.

Consul-General Robert P. Skinner, writing from Hamburg, describes the use of wireless telegraphy among German fishing vessels: Three Cuxhaven steam trawlers are now equipped with apparatus, and the service is so satisfactory that efforts are being made to increase it. The most marked advantages resulting from the use of the wireless telegraph in this business are the ability of captains to advise with each other at sea as to their respective catches, and the transmission of similar reports to Cuxhaven a number of hours before the return of the ships to port. Thus vessels of the same fleet which have found poor fishing are sometimes able to join other vessels more fortunately located, in time to return with good catches. All the vessels are then able to inform the managers of the public markets respecting the quantities of fish to be placed on sale, in such manner that in the event of unusual catches arrangements can be made in advance for distributing supplies in the least possible time. The receipt and transmission of hydrographic intelligence and reporting of breakdowns in engines, or other accidents of navigation are also features of importance.

Examination for testing engineer is announced by the United States Civil Service Commission on July 27, 1910, to fill a vacancy in the position of engineer in timber tests, $1200 per annum, Forest Service, Madison, Wis., and vacancies requiring similar qualifications as they may occur.

THE HISTORY OF GAS-LIGHTING IN SACRAMENTO.

BY E. C. JONES.

Sacramento, the capital of California, derived its name from the Spanish of the ecclesiastical word sacrament, meaning "an outward and visible sign of an inward and spiritual grace." The story of how the Sacramento Valley was explored and settled by Captain John A. Sutter recalls the experiences of the pilgrims who first made their homes on the shores of Massachusetts Bay nearly three hundred years ago. This pioneer settler of California was confronted by all the hardships, disappointments, and dangers of the Puritans, with the single exception of the wonderful advantages of California climate. But the troubles of the California pioneer were ever tempered by sunshine and warmth. Seventy years ago, and well within the memory of many who are still living, the site of the present city of Sacramento was little known to white men and was occupied by hostile tribes of Indians.

Captain Sutter had received information in his Missouri home as to the mildness of California's climate and the productiveness of its soil, and he was filled with enthusiasm to be among the first to settle in so attractive a country.

He left Missouri in April of 1838 with a small company bound for California. The overland journey was slow and full of difficulties. He attempted to reach California by way of the old "Oregon trail." But when he reached the Willamette River his men deserted him. So he took passage on a Hudson Bay Company's vessel that was going to the Sanwich Islands. He hoped that he would be able there to reship to the coast of California. But he was disappointed, and left the islands in a vessel bound for Sitka. After some delay he came down the coast in the brig "Clemintine" and arrived at Yerba Buena (now San Francisco) July 2d of 1839. As Monterey was then the only port of entry he was compelled to go to that point before the vessel could be formally entered in accordance with the Mexican custom-house regulations.

At Monterey Captain Sutter explained to Governor Alvarado the interest he had long felt in California, and expressed his desire to settle in the Sacramento Valley.

The Indians of the northern part of California had all along been hostile to the settlement of Mexicans in their territory, so the proposition of Captain Sutter to locate in that dangerous region was favorably received. He was given permission to explore the rivers and to select and take possession of any location that pleased him, and was assured that after one year from the time of settlement he would be given title to the lands. With this encouragement, he returned to Yerba Buena, chartered the schooner "Isabella," purchased some small boats, and began the exploration of the Sacramento River. He was eight days in discovering which was the main channel of the river, and then he sailed up-stream to within ten miles of the present city of Sacramento. He was met by armed and painted Indians. But he succeeded in satisfying them of his peaceable designs, and a treaty was made. He was allowed to proceed up the river, accompanied by two Indians, and he ascended in his schooner as far as the mouth of the Feather River, and in small boats went on up the Sacramento some distance further. After exploring the country he returned to his little schooner and found his men in a state of mutiny. They demanded that he should abandon so foolhardy an expedition in that useless wilderness. But Captain Sutter was determined to succeed, and he returned to the mouth of the American River, which he entered August 12th of 1839. He ascended the American River about three miles, discharged there the cargoes of his boats, pitched his tents, and mounted small cannons as a means of defense and to intimidate the Indians. Here he broke the spirit of insubordination among his men, but the party was divided. Three white men decided to remain with Captain Sutter. Although satisfied as to the bad faith of the natives, he hoped to gain their assistance in carrying out his designs.

The Indians were scattered over the country in tribes and had their rancherias located at various points in the valley, along the course of the streams. At the time of Captain Sutter's arrival one of the most powerful of the tribes were the Nemshous, who ranged between the Bear and American rivers. Across the Sacramento were the Yolos, and on the north side of the American were the Bashonees. The Indians found by Sutter were degraded and worthless, inhabiting miserable mud holes or adobe huts, and subsisting on fish, acorns, roots, and small game. They were too lazy and stupid to hunt the larger game, which was so plentiful in the country at that time.

The first site Sutter selected on the American River was a place now known as Stewart's. But it was not entirely satisfactory. So Captain Sutter began in 1840 building Sutter's Fort at its present location. In 1841 an adobe building was constructed at the first landing, a place known later as the Tan Yard. Soon after that Sutter constructed a good-sized adobe house of two stories and three smaller houses, all surrounded by a wall, and these comprised Sutter's Fort. This work was accomplished by enlisting the labor of friendly Indians, whom he had succeeded in partially civilizing. These Indians were then employed in opening a road through the chaparral to a landing point on the Sacramento River two miles distant and called the Embarcadero. This name was retained until 1849, when it was changed to Sacramento.

Captain Sutter had enclosed a large tract of land with a ditch, and had commenced the cultivation of the soil. In two years he had established himself in power and authority. He surrounded himself with the best obtainable mechanics. Work of various kinds was carried on within the walls of the fort. He also formed a company of soldiers, selected from the best of the natives of the country. And when Fremont, "the pathfinder," arrived from the East he found at Sutter's Fort forty Indians in uniform, thirty employed white men, and twelve pieces of mounted artillery. Sutter's Fort was then capable of holding one thousand men, and there were two vessels at the Embarcadero belonging to Captain Sutter.

During the rebellion in 1844 Captain Sutter was called upon to aid in sustaining the Mexican government. As a result of that little revolution Pio Pico was

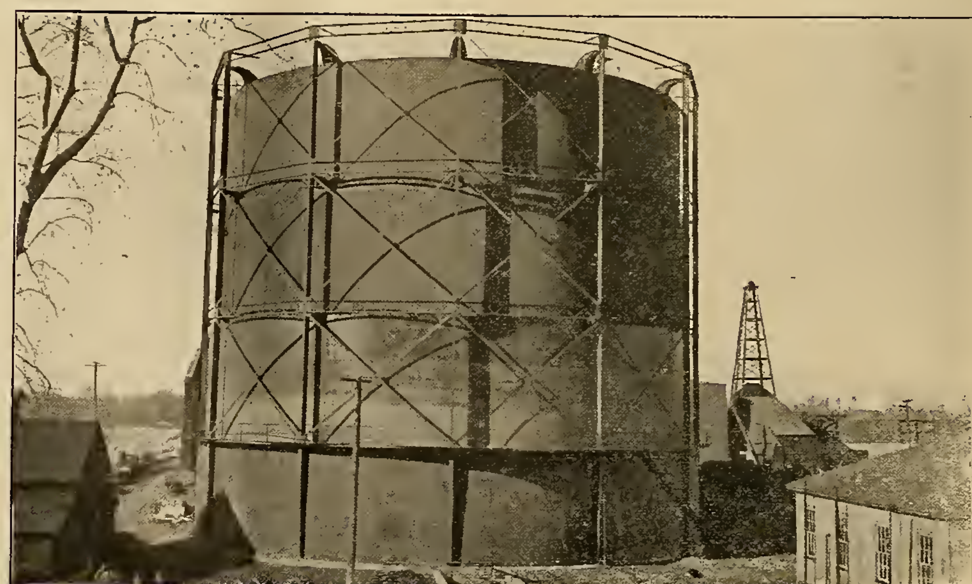
made governor, and he retained the office until the war with the United States. A revolution later broke out among the Americans, who, before the Mexican war, took possession of Sutter's Fort and raised the first flag of independence. This movement was known as the Bear Flag Revolution, from the revolutionists' banner, on which was painted an emblem representing a grizzly bear. During this encounter General Vallejo and other Mexicans were held as prisoners at Sutter's Fort for about three weeks.

The war between the United States and Mexico began in May of 1846, and Commodore Sloat was directed to occupy the ports of upper California. The 7th of July the American flag was raised in Monterey, the 9th of July at the plaza at Yerba Buena (now Portsmouth Square in San Francisco), and soon after at Sutter's Fort and other places.

After the arrival of James Marshall, a millwright, Captain Sutter determined to build a sawmill. They selected a location far up on the American River at what is now Coloma. This place had all the natural advantages necessary for the successful operation of a sawmill. Marshall, with seventeen men, began in the winter of 1847 to build the mill. In January of 1848, while Marshall was employed in enlarging the millrace, he made the first discovery of gold in California. Marshall hastened on horseback to report his discovery to Captain Sutter at the fort, where he exhibited about two ounces of scale-like particles of gold. Captain Sutter desired to keep this discovery a secret, as he was depending on the mill at Coloma for lumber which he needed for building operations. But it was impossible to conceal a fact so important and interesting. Despite all precautions, the quiet mining operations were discovered. A general stampede resulted. The discovery of gold caused a rush to the diggings. Seekers of gold made their way up the Sacramento River. The first party of these gold-seekers landed at the Embarcadero November 2d of 1848. There was not a house there. The only place of business of the future Sacramento

Sutter's Fort, Now Within the City of Sacramento.

General View at the Sacramento Gas Works.



The 500,000-Cubic-Foot Gas Holder at the Sacramento Works.

AN OLD GROUP AT THE SACRAMENTO GAS WORKS.
Left to right—John Hines, Jim Cousins, Harry Keefe (in white), James Apple, Supt. George W. Jackson, Engineer Dennis Brophy, John Logue, John Brophy (hat at chin), Pat Spain, James McGunigan, J. Francis, Con McCann (bare arms), John Quigley, James Quillihan (shovel), John Roach.

was an old store-ship aid up by the bank trade and a little town in itself. It was rented to merchants at $60,000 a year. The principal establishment was the general store of Samuel Brannan & Co. At that time flour was sold at $60 a barrel, pork at $50 a barrel, and sugar at 25 cents a pound.

In December of 1848 Captain William H. Warner surveyed and laid out what is now the city of Sacramento. The first building in the new town was erected by Samuel Brannan, and it was completed January 1st of 1849. It was located at the corner of J and Front streets, and stood there until the fire of 1852. During all this time the town of Sacramento remained under the nominal government of an alcalde, or mayor. But with the 1st of August of 1849 a meeting of a town council was held, and after six weeks' deliberation the councilmen submitted a draft of a city charter. This proposed charter was defeated by 146 votes, but was afterward approved by a majority of 295 votes.

The population of Sacramento October 1st, 1849, was 2000, and at that time there were forty-five wooden buildings and three cloth houses in the town.

The Old Office Building at the Sacramento Gas Works.

Pier on Sacramento River Where Fuel-Oil Is Delivered at the Gas Works.

One evening in January of 1850 the town was suddenly inundated by a rise of the river. So high did the water come that vessels of ordinary size could sail as far in as Sutter's Fort, and the entrance to the City Hotel was from boats landing at the second-story windows. This flood lasted but a few days. The 7th of April the waters again flowed into the town, and the day following the city council voted an appropriation for constructing a temporary levee. When this work was accomplished the principal business districts of Sacramento were protected against flood water.

This enterprising young city was the second in the State of California to introduce illuminating gas. Many interruptions prevented the completion of the gas works. July 15th, 1854, the city was nearly destroyed by a fire which consumed ten entire blocks in the central part of the town with more than two hundred frame buildings. During that year a new levee was constructed, one thousand new houses were erected, one hundred and fifty of which were substantial brick improvements, and the streets of Sacramento were raised and planked to a grade above the high-water mark. Had it not been for unforeseen events the gas supply would have been the first public utility in Sacramento, then a town of some 8000 people. But during 1854 a water works was first installed. This was the first city water works established on the Pacific Coast.

The 25th of Februray, 1854, an act passed the Legislature declaring Sacramento the capital of the State, and March 1st, 1854, the Governor, State officials, and the Legislature arrived and were received by the city corporation, the Sutter Rifles, and the assembled citizens.

June 5th of 1854 a Scotchman named William Glenn obtained a franchise to build and operate a gas

works in Sacramento. This was the same year that gas was introduced in San Francisco. But Glenn did not proceed with the building of the works. He sold his right to others who organized August 18th, 1854, under the name of the Sacramento Gas Company. Angus Frierson was elected the first president, and N. W. Chittenden, the secretary.

October 20th, 1854, Mayor R. P. Johnson took the initial step in the construction of the gas works by turning the first soil in excavating for the gas-holder tank. The progress of the work was seriously interrupted, and the undertaking was abandoned March 7th, 1855, on account of the rise of the American River and the submerging of Slater's Addition, where the new gas works was being built.

But August 14th, 1855, work was resumed, and was carried to a successful completion.

Sacramento was first lighted by gas the evening of December 17th, 1855. At that time the officers of the company were R. P. Johnson, president; P. B. Norman, engineer; H. W. Watson, secretary; D. O. Mills, treasurer; and James Murray, W. F. Babcock, L. McLean Jr., R. P. Johnson, and W. H. Watson, directors.

The retort house was a brick structure 54 ft. long, 51 ft. wide, and 21 ft. high, covered by an iron roof. The adjoining purifying house was 35 ft. long, 25 ft. wide, and 18 ft. high in the clear. The purifying house had a water-tight cellar built on arches. The meter house and offices occupied a building 37 ft. long, 25 ft. wide, and two stories high. A great deal of pride was taken in the gas works' chimney, which was built of brick and was 85 ft. high.

The gas-holder tank was 52 ft. 6 in. in diameter and 20 ft. deep. It was made of brick and rested on a pile foundation. The buildings and brick-work were constructed by Carr and Winons of San Francisco, and all of the iron-work was furnished by James and Peter Donahue of San Francisco.

In 1856 the average daily output of gas was from 8,000 to 10,000 cu. ft. The selling price was $15 the thousand, and there were 113 consumers.

In 1863 the number of consumers had increased to 600, and then the city contracted for 45 street lamps at $9 a month each, the lamps to be lighted only during the session of the legislature! A new gas holder was constructed in 1869 with a capacity of 60,000 cu. ft.

February 1st, 1870, the price of gas was reduced to $7 the thousand cu. ft., and there were at that time 33,000 ft of street mains in use. During that same year the price was further reduced to $6 the thousand, at which rate it was held for several years.

In 1871 there were 50,000 ft. of gas mains in the streets of Sacramento. The officers of the company at that time were Charles E. McLane, president, and H. B. Forbes, secretary, and John Q. Brown was the superintendent. January 8th, 1872, opposition came into the field under the name of the Citizens Gas Light and Heat Company. The trustees of this new concern included many well-known men of Sacramento, and the first officers were W. E. Brown, president; Robert C. Clark, vice-president; Albert Gallatin, treasurer; and J. W. Pew, secretary. This Citizens gas company proceeded to build a works on a 600- by 240 ft. area on the river-front, between T and U streets. The erection of the works began there in February of 1873, and the plant was completed in December of that year. Eighteen miles of street mains were laid. The plant included a substantial retort house, containing 5 benches of 5 retorts each, a purifying house, and all the apparatus necessary for a complete coal-gas works, also a brick office building, which contained an 8-ft. station meter and rooms for the directors and for the transaction of the regular business of the company. This gas works was the nucleus from which has grown the present well-equipped works of the Sacramento Electric, Gas and Railway Company of today.

January 1st, 1875, the Sacramento Gas Company and the Citizens Gas Light and Heat Company were consolidated under the name of the Capitol Gas Company, with a capital stock of $2,000,000 in 40,000 shares of $50 each. The gas-making operations of the new combination company were carried on at the works of the Citizens' Gas Light and Heat Company, between T and U streets and Front street and the river-front. At this works there were three 60,000 cubic foot gas holders for the storage of gas. These holders continued to be the sole dependence of the company until the construction in 1908 of the 500,000-cubic-foot modern gas holder.

In 1878 the retort house of the Sacramento Gas Company was sold and converted into a warehouse, and the railroad company bought the old gas holder and the land on which the holder had stood. So the plant of the Sacramento Gas Company, with the exception of its street-main system, passed out of existence.

When the present State constitution was adopted the capital stock of the company was reduced to 10,000 shares, at a par value of $50 a share.

The report of the superintendent, John Q. Brown, for the year ending 1876 gives the amount of gas made that year as 36,033,000 cu. ft., with a leakage of 17 per cent. It deals with the re-arranging of the mains and services due to the consolidation of the two companies, and states that all of the apparatus at the old works was taken down and that those parts in good order were utilized for improvements and additions to the new works.

During 1876 quite extensive improvements were made to the works that had been acquired by the consolidation and five benches of retorts were added, making ten in all. That year there was constructed a new coal shed, 40 by 120 ft. This shed remained in use until it was dismantled during the month of December, 1909.

In 1876 the gas was made from Sydney coal, costing $12 the ton, enriched with "kerosene shale" from Australia and costing $25 the ton.

In 1887 the officers of the Capitol Gas Company were B. U. Steinman (afterward mayor of Sacramento), president; Oliver Eldridge, vice-president; and C. H. Cummings, secretary and treasurer.

March 21st, 1887, John Q. Brown resigned as superintendent of the gas works to accept the position of state gas inspector, and was succeeded temporarily

by J. R. Watson, who, in turn, was succeeded September 1st of that same year by George W. Jackson as temporary superintendent. Jackson was then clerk of the company, and J. C. Pierson was appointed the permanent superintendent. Pierson retained this position until 1894, when he retired to attend to his mining interests. He was succeeded as superintendent by George W. Jackson.

July 1st, 1887, the Capitol Gas Company consolidated with and absorbed the Thomson-Houston Electric Light Company, thereby disposing of a competitor and combining the electric-lighting and the gas business.

In 1896 the Sacramento Electric Gas and Railway Company was formed by the consolidation of the Sacramento Electric Power and Light Company and the Folsom Water Power Company, and in 1902 this company acquired by purchase the Capitol Gas Company.

In March of 1903 the Sacramento Electric Gas and Railway Company was acquired by the California Gas and Electric Corporation. During the many changes in corporate title and the advancement in the art of gas-making the method of making gas was also changed.

A plant for the manufacture of water-gas from anthracite coal and petroleum was constructed, and it was used in connection with the coal-gas works. As petroleum became more plentiful and cheaper, water-gas displaced coal-gas.

In 1903 another advancement in the process of manufacture was made by the introduction of crude-oil water-gas, using California petroleum exclusively for the manufacture of gas. With the development of the process of making gas the quality was improved, and the price was reduced to $1 the thousand cu. ft. which is the rate now charged in Sacramento.

The late George W. Jackson was succeeded as superintendent of the gas works by R. P. Valentine, and when the company passed into the hands of the California Gas and Electric Corporation the late Albert Gallatin was made its manager. Then in turn came Frank A. Ross and F. E. Fitzpatrick as managers.

In January of 1906 the Sacramento Electric Gas and Railway Company became a part of the Pacific Gas and Electric system, and is now under the management of C. W. McKillip, with Edward S. Jones as superintendent of the gas works.

Since the Sacramento works has passed into the hands of the Pacific Gas and Electric Company great improvements have been made in the plant, new and larger sets of oil-gas generators have been installed, new purifiers have been constructed, and a 500,000-cubic-foot storage holder has been built. The street-main system has also been extended to keep up with the growth of the city, and a high-pressure gas system has been installed at Oak Park, a large and rapidly growing suburb of Sacramento. In 1909 it was decided to increase the oil-storage capacity at the gas works, and a 10,000-barrel, steel oil-tank was placed upon a barge in San Francisco and towed up the Sacramento River, moved over the levee, and placed upon a foundation in the yard at the gas works.

CLEANLINESS AND ECONOMY IN POWER PLANTS.[1]

BY THOMAS J. WALSH.

It will be my endeavor briefly to point out to what extent the costs entering into the production of power may be affected by the proper attention to cleanliness about the power station.

The added exertion necessary to keep equipment and building tidy and free from accumulation of dirt, with all its attendant influences on the deterioration of the apparatus, is so slight, while the benefits are so marked, that there can be no question as to its expediency. No one will deny that the replacing of tools and supplies in their proper places, the removal of foreign matter from any part, the gathering up of waste scraps for easy disposal, the tightening of a loose joint or the replacement of a fractured pipe or fitting in the oil piping, require but the minimum of attention at the appropriate time. Few things are more disheartening to an engineer than the wail of a "dying" turbine, or the laying down of an engine under load, especially with the tools scattered about the plant. Then, too, when the cleanliness of engines and boilers is neglected, the increase in coal consumption becomes at once noticeable; and where there is leaky oil piping, the oil bills must increase as oil is thrown about the engine room floor and into fly-wheel pits, or into generator windings and commutator with destructive effects, especially when the cleaning is neglected.

No stronger proof could be brought forward as to the efficacy of the attentions as urged here in this article than the consideration of the power plants of Holland. The wonderful economic results obtained from the obsolete equipment in those stations was remarked some time ago by the editor of the Street Railway Journal, and together with these economic results was mentioned the remarkable cleanliness of everything about the plant, not only superficially, but of the invisible parts as well.

And in our own country it is only necessary to observe those stations where economy in the production of power is the aim of the entire personnel, to obtain added proof as to the advantages of cleanliness. One need not look for highly polished brass railings or nickel-plated tools, but one does find no waste of oil, every tool in its place, an orderly supply cabinet or locker, convenient receptacles for clean and dirty coal, feed pumps and lubricators free from accumulation of dust. These will be the most marked, but it is safe to predict that these visible signs are faithful indications of an excellence in the maintenance of the internal parts of the equipment.

As affecting the costs entering into the production of the output, the boiler room contains great possibilities of economic results where cleanliness is properly attended to. The confining of coal in neat piles on the firing floor, or in the containing cars, is not only pleasing to the eye, but firing and the cleaning of fires is simplified by the freedom afforded the firemen in moving about, and furthermore the coal does not become mixed with the ashes. Clean fires and clean

[1]Public Service Journal.

ashpits mean efficient combustion as well as increased capacity. Clean drums and tubes, internally and externally, are likewise necessary for efficiency, an instance being known where an ordinarily well operated station increased its rate of coal consumption two and one-half per cent by neglecting the daily blowing or dusting of tubes for a week. And aside from the reduced coal consumption this cleanliness means longer lived grates and tubes, with the resulting decrease in maintenance charges. Clean feed pumps, plungers or rods protected or kept free from grit, insure a longer life to those parts, as well as a reduction in charges for waste, drip pans under the auxiliaries, neat piles of packing; while lubricators similarly attended to provide clean oil at all times to still further reduce the friction to be overcome. And increased friction means increased coal consumption.

In the engine room a systematic overhaul and cleaning of all parts, internal as well as external, reduces maintenance charges to a minimum, the consequence being increased useful life to the machine. Inspection of engine cylinders and turbine rotors discloses accumulation of carbon, scale and other foreign matter that may easily counteract much of the care devoted to the boiler room equipment previously mentioned. Carbonized oil, due to an excess of lard or tallow, or metal flake carried over from the boilers with the steam, while blocking up steam ports of valves, is also sure to cause scored cylinders; and under certain conditions blades of turbines will accumulate scale to a degree hardly imaginable, but which is only disclosed by inspection, such a condition being obviously destructive of all the refinements accorded to the previous stages in the chain of conversions. Bearings, pins and boxes likewise need only to be examined to bear out this discussion, indicating the necessity for frequent cleaning of oil grooves if lubrication is to be effective.

This argument extends to the other machines making up the engine room equipment.

Care should be given to offices and workshop in the same way; the effect of such a general scheme of cleanliness could not but be beneficial to each member of the operating crew.

As affecting the fixed charges, the surplus capacity in a plant could reasonably be lower where operating engineers of a high grade were known to be in charge, men who would insist upon the maintenance of all equipment in first-class operating condition. In this way the investment charges might be materially reduced. As to the depreciation charges, the assumption of a continued regime of cleanliness would hardly justify a reduction; yet to find at the end of its useful life in a particular station—or when it shall have been superseded—that the depreciation on a machine has been overestimated, is a much more satisfactory outlook than would be the reverse.

So, too, oily waste thrown around and oil saturated floors — particularly in wooden structures — increase the fire risk, and this must be provided for by a higher insurance rate.

Granting then the improved efficiency of the equipment, as well as of the men, and the possible reduction in investment, depreciation and other fixed charges, it becomes obvious that for the successful operation of a power station the first essential is cleanliness.

A systematic and careful cleaning of every piece of apparatus in use in the station will in the beginning disclose weaknesses to be attended to before becoming too serious. The application of a wrench to a loose nut or bolt, or the careful cleaning of electrical apparatus from oil, might easily prevent highly destructive consequences. This attention should be given not only to the main units but also to pumps, heaters, condensers, all piping, traps, oil tanks, filters, water measuring devices, scales, motors, rheostats, switchboards, instruments, etc. Thus the concerted action of the whole operating crew will avert the time when the failure of a machine through neglect will mean hours of strenuous labor, with correspondingly high maintenance charges for the renewal of parts, and a serious crippling of the service.

THE WATTHOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

(Continued.)

APPENDIX.

Definitions.

In many respects electric circuits closely resemble a water system, in which the pressure is analogous to the voltage of the electric circuit and the quantity (in cubic feet per second) to the current flowing in the wires. This comparison will often aid in the solution of various electrical problems.

Definitions.

Ampere=the unit of electrical current, and is that current which will deposit silver at the rate of 0.001118 grams per second when flowing through an electrolytic solution of silver nitrate.

Ohm=the unit of resistance, and is equivalent to the resistance of a column of pure mercury, at 0° centigrade, 103.6 centimeters high, of uniform cross section, and weighing 14.4521 grams.

Volt=the unit of electrical pressure (electromotive-force), and is that pressure which will maintain the flow of one ampere of current against the resistance of one ohm.

Let R=the resistance of a given circuit, E the voltage impressed and I, the current in amperes, then for direct current,

$$E = R \times I \text{ (Ohm's Law)},$$

which is the fundamental equation of direct current circuits.

Watt=the unit of electrical power; the watts equal the product of the volts and the amperes in direct current circuits, and to the product of the volts, the amperes and the power factor in alternating current circuits. (See Chap. II.)

Kilowatt=one thousand watts.

Watthour=the unit of electrical energy, and is equivalent to the flow of one watt for one hour.

Kilowatt-hour=one thousand watthours.

Inductance: The inductance of an electrical circuit is the property of that circuit whereby it can convert electric energy into magnetic energy, and vice versa.

Inductance bears a close resemblance to "inertia" in mechanics, and has been called "electrical inertia." Inertia is that property of a moving body whereby it resists any change in its velocity; if a rapidly moving body is suddenly stopped, as, for example, a hammer striking a nail, a great force is exerted by the body against the obstacle which brings it to rest; the magnitude of the force depending upon the suddenness with which the moving body is stopped and upon the inertia of the body. In an electric circuit containing inductance, if the current is suddenly interrupted, a high e.m.f. is produced which tends to cause the current to continue. The magnitude of this "induced" e.m.f. depends upon the suddenness with which the current is interrupted and upon the inductance of the circuit. The inertia of any given body is proportional to its mass; the energy stored in a moving body is $W = \frac{1}{2} MV^2$, where M is the mass (= weight divided by the gravitational constant), and where V is the velocity. The magnetic energy stored in an electric circuit due to its current and inductance is $W = \frac{1}{2} LI^2$, where L is the inductance and I is the current.

Henry=unit of inductance; a circuit having an inductance of one henry will have an e.m.f. of one volt induced in it by a current changing at the rate of one ampere per second.

Milli-henry=0.001 henry.

Power Factor=the ratio of true watts to apparent watts (see Chap. II).

Cycle—one complete wave or alternation of current or e.m.f. (See Fig. —, Chap. II.)

Frequency=number of cycles per second.

Impedance=the vector sum of the resistance and the reactance of an electric circuit and is expressed by the following equation:

$$Z = \sqrt{R^2 + X^2},$$

in which R is the resistance in ohms, and X is the reactance ($= 2\pi f \times L$, where f is the frequency in cycles per second and L is the inductance in henrys). The voltage drop in an alternating current circuit containing both reactance and resistance is

$$E = Z \times I,$$

where Z is the impedance as above expressed and I is the current in amperes.

Determination of Temperature Rise by Resistance Method.

In testing electrical machinery such as generators, motors and transformers, it is impossible to obtain the internal temperature of the windings by use of thermometers; the following formula will therefore be useful in determining the average temperature of such windings:

$$\text{Rise in temperature} = (238 + t)\left(\frac{F}{R} - 1\right)\text{degrees C},$$

in which 238 is a constant; R is the initial resistance of the winding at a room temperature, t, and F is the final resistance. If the room temperature differs from 25° C, the calculated temperature should be corrected by ½% for each degree C. Thus with a room temperature of 15°, the rise in temperature should be increased by 5%, or if the room temperature is 35°, the rise in temperature as calculated should be decreased by 5%, etc.

Adjusting Meters for Use With Current and Potential Transformers.

The usual method of testing watthour meters used with current and potential transformers is to test and adjust the meters without the transformers, taking into consideration, of course, the ratio of the transformers. Where a great degree of accuracy is not required, this procedure will answer very well; but where, as with large consumers, a small percentage error represents a considerable sum of money, the errors introduced by the current and potential transformers should be taken into account and, as far as may be, compensated.

The errors introduced by the current and potential transformers are (1) errors in ratio of the transformers and (2) errors due to improper phase relations between the primary and secondary currents and e.m.f.'s.

The errors due to ratio can be easily compensated by adjusting the meter in accordance with the ratio curves of the transformers at unity power fatcor. The ratio of the potential transformer will remain constant as its load is constant. The ratio of the current transformer will not remain constant, but will vary with the load. It tends to make the meter fast at full load and slow at light load. This can be compensated by adjusting the meter to be a little slow at full load and fast at light load.

The errors due to improper phase relations between the primary and secondary currents and e.m.f.'s are of more serious nature and more difficult to eliminate than errors due to ratio. The errors from this source are negligible at unity power factor, but may be considerable at low power factors, depending on the design of the transformers.

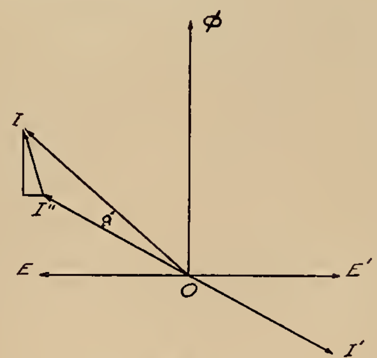


Fig. 1.

The diagram, Fig. 1, shown below, is a vector diagram of a current transformer. OI is the primary or line current, OI' is the secondary current and lags behind OE', the secondary e.m.f. of the current transformer, by an angle depending on the power factor of the secondary load (meter coils and leads). II'' is the exciting current, the magnetizing component of which is at right angles to and the energy component in phase with the primary e.m.f., OE, of the current transformer. OI'' is that component of the primary current inducing a current in the secondary, or is the secondary referred back to the primary. It will be seen that OI' leads OI by and angle α which will tend to make the meter run fast on inductive loads.

(To be continued.)

CALIFORNIA OIL FUEL.

BY R. F. CHEVALIER.

GAS ANALYSIS (Continued).

Manipulation.

To obtain a sample of gas for analysis, connection is made with rubber tubing between the free end of the connecting tube D and a sample tube inserted either in the stack or pass of the boiler to be tested. The gas is first collected in burette B for measurement. This measuring burette is usually of 100 cubic centimeters capacity and, as already mentioned, is surrounded by a glass cylinder containing water for the purpose of maintaining the gas at a nearly uniform temperature.

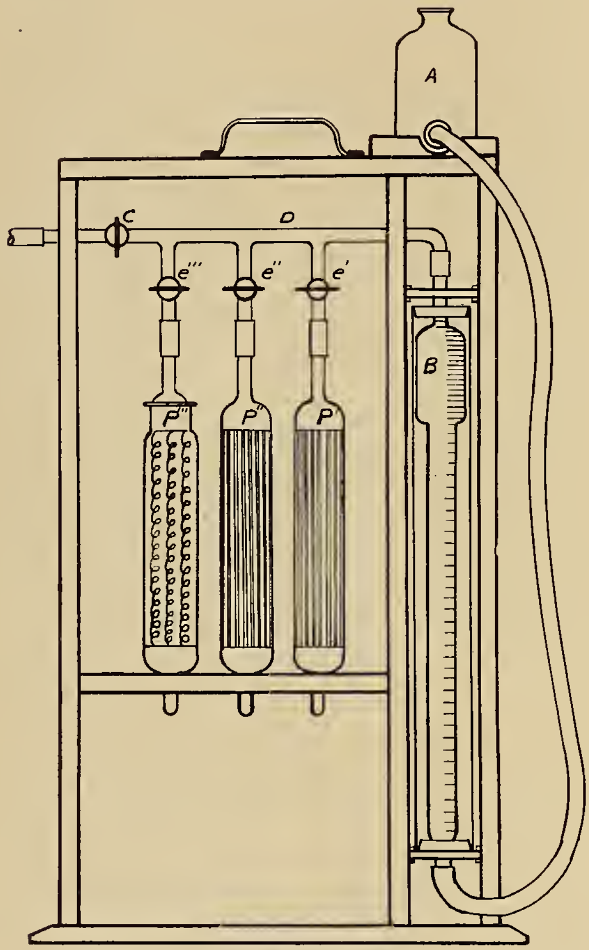


Fig. 1.

The first 50 cc of the burette are in divisions of 0.2 cubic centimeter, the remaining in one cubic centimeter divisions. To fill B with the gas to be sampled, cocks e' e'' e''' are closed and cock C is turned horizontal, at the same time lowering bottle A until the gas in B reaches the zero point. This first sample collected is not the true sample. The sample tube and connecting rubber tubing are filled with atmospheric air which must be withdrawn. On reaching the zero point or thereabout, C is turned so that upon raising the bottle A the gas or air in B is expelled to the atmosphere, and when the water in B reaches the 100 cc mark C is again turned horizontally, simultaneously lowering the bottle A, thereby drawing another sample from the tube and again expelling to the air. This operation must be repeated three to five times, according to the capacity of the sample and connecting tube. The air in the tubing being finally displaced B is carefully filled with gas to the zero point (100 cc or parts) and C closed. All measurements are made by bringing the level of the water in the bottle to the same level as the water in the burette. Particular attention must be paid to this method of reading measurements, for if the bottle is raised or lowered, the gas will be compressed or expanded. A certain amount of water clings to the side of the burette, which, if given time, will drain; therefore all measurements should be made accordingly, i. e., if thirty or sixty seconds are allowed to elapse between leveling the water in bottle and burette, and the reading, the same time should elapse between these events when another measurement of the same sample is made.

The order of determination and respective pipettes for the gases are as follows:

1st—carbon dioxide (CO_2) ....Pipette P'
2nd—oxygen (O) ....Pipette P''
3rd—carbon monoxide (CO) ....Pipette P'''
4th—nitrogen (N) ....by difference

Determination of Carbon Dioxide.—To determine the carbon dioxide the stop cock e' is opened, the bottle A raised, forcing the gas into P'. The gas displaces the reagent in the front and forcing it to the rear part of the pipette, exposes the glass tubes, which, covered with reagent, offer a large absorption surface. A is lowered again until the reagent is brought approximately to its initial point in the stem, when the bottle is again raised and again drives the gas into P'. This operation is repeated three or four times, when the gas is returned to the burette for measurement, the reagent brought to its initial point on the stem, and the glass cock C' closed. The water in bottle A is leveled with that in the burette, and the reading taken. The difference in volume is the CO_2. The burette is marked so that the difference in volume may be read in per cent.

Determination of Oxygen.—After measurements, the residue from the absorption of carbon dioxide is passed into P'' in the same manner until no further diminuation takes place. The absorption of oxygen is much slower than that of carbon dioxide. The difference between the reading obtained, and that after the absorption of carbon dioxide is the per cent of oxygen in the gases. Fastened to the neck, at the rear of pipette P'' is a rubber bag to keep out the atmospheric oxygen, at the same time allowing the air in the pipette to be displaced.

Determination of Carbon Monoxide.—The gas is then passed into P''' for absorption of carbon monoxide, but before being measured, the gas must be passed into P' to remove hydrochloric acid vapors retained by it after contact with the reagent for carbon monoxide. The per cent of CO being small and the gas difficult for a reagent to act upon, considerable skill is required for this determination. The method of measuring the gas in the burette is similar to that already described for CO_2 and O.

Nitrogen.—After the absorption of the above gases, the residue left is usually nitrogen. In some instances, hydrogen exists, but its determination is rather difficult.

(To be continued.)

THE MECHANICS OF THE STEAM ENGINE.

In the Journal for June 11, 1910, a diagram for graphically showing the velocity of the crosshead was given. The velocity was there found to be proportional to the vertical distance from the shaft center to the connecting rod (extended if necessary). In Fig. II this velocity was shown to be proportional to the length OS.

By this diagramatic construction it will be noted a velocity is represented as a definite length of line. If, now, we can determine the rate of change of the length of this line; that is, the velocity of one end away from the other due to the line's lengthening, we shall have a value for the acceleration of the crosshead. For the change of velocity of the crosshead is represented by a change in the length of the line OS and hence the rate of change of the line's length will represent the rate of change of the crosshead velocity, that is to say, its acceleration.

Professor Le Conte has shown this by an interesting extension of the above mentioned figure.

In Fig. V the crosshead velocity is again indicated by the length OS.

Consider, for the purpose of reasoning, that the point S is actually a point in the connecting rod. By the use of the instantaneous center I the velocity of S is found to be in a direction and of the value of SN. The construction for this is to draw an arc from Q to M with center at I and extend the tangent line Mu to equal the velocity of the point M. For instance, imagine the rough line to enclose a surface which is moving rigidly with the connecting rod. The velocities of all points in this surface will be at right angles to the line connecting such point to I, that is, tangent. In the case of the point M the velocity will be equal to that of Q since their distance from I is the same. The velocity of S, however, will be greater as shown by the triangle NSI, but will be parallel with Mu. S, then, considered as a point of the connecting rod is moving in a direction and equal to the line SN.

By parallelogram construction this velocity is resolved into two components, one in the direction of the connecting rod Su and the other vertical ST. It is the vertical component in which we are interested. This line ST represents the velocity of the point S in a vertical direction. But the velocity of S is the acceleration of the crosshead. Therefore, ST is equal in length to the acceleration of the crosshead on the same scale that OS in length represents the velocity of the crosshead.

The following example will help to a thorough understanding of this construction.

In Fig. V assume the following:

Length of crank, OQ......... 20 inches
Revolutions per minute.......160

Then the velocity of the crank pin will be $2 \times 3.14 \times 20 \times 160 = 20{,}000$ inches per minute or 333 inches a second. When the crank is in a vertical position the velocity of P is for the instant equal to that of Q; also the point of intersection S, of the connecting rod with the vertical line through O is at this instant the crank pin itself. The length of the crank, then, or 20 inches will represent 333 inches per second velocity; or 1 inch on the line OS represents 16.6 inches per second of crosshead velocity. Thus our scale of velocity is determined. For any position of the crosshead its velocity may be determined by simply extending the line of the connecting rod till it intersects the vertical line through the shaft at S. Then OS in inches multiplied by 16.6 equals the velocity of P.

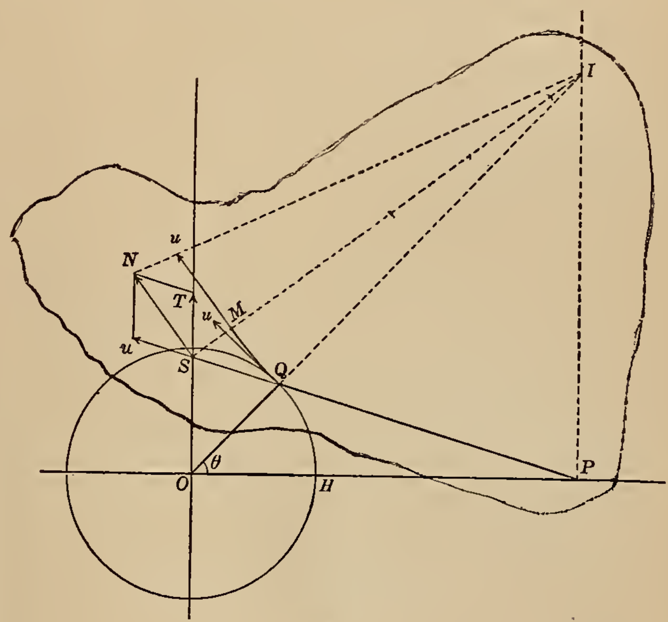


Fig. 5.

The velocity of Q = 333 inches per second, which is also the velocity of M. By measurement, or by comparing the triangles Mu will be found to be 9/10 of SN. Hence SN = $10/9 \times .333$ = 370 inches per second.

Also by either measurement or calculation ST will be found to be equal to $\frac{SN}{\sqrt{3}}$ = 213 inches per second.

The velocity of S is therefore 213 inches per second. Hence the acceleration of P at the instant under consideration is 213 inches per second, which means that if the acceleration of P were constant for the second of time next succeeding the instant under consideration, the velocity of P at the end of this second would be 213 inches per second greater than shown (OS) or about $300 + 213 = 513$ inches per second. In reality the velocity at this latter instant of time would be different from this amount because the acceleration throughout the second would not necessarily remain constant, but the above numerical example illustrates the use of the diagram in determining instantaneous velocities and accelerations of the crosshead.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Smokeless Combustion

A smokeless city, like a noiseless Fourth of July, is a matter of education. Persistent agitation has finally forced many cities to prohibit fireworks. The past week's reports show that as a result there has been much less fire havoc and fewer people have been injured or killed. While smoking chimneys have not exacted the same terrible death toll as exploding firecrackers, their cumulative year's damage to surrounding property and their involved waste of fuel gives a greater annual loss than may be ascribed to the fireworks of the festive Fourth. In consequence, anti-smoke ordinances have been adopted by many Eastern cities, so besmirched, and the question is now being investigated by certain Western bodies.

They find that smoke consists chiefly of unburned fuel. Hydrocarbons are volatile at temperatures far below their point of ignition and unless there be ample furnace space and abundant air supply, they are apt to escape up the flue unconsumed. If the furnace flame strikes the comparatively cold surface of the boiler shell before its burden of carbon dust and hydrocarbon vapor is all burned, it is extinguished just as by the wire gauze of a miner's safety lamp. Passing on as dense black smoke it poisons the air and pollutes everything which it touches. By enlarging the combustion chamber so as to interpose more space between the grate and the boiler the gases are burned before being cooled and the smoke is minimized. Such change in boiler design together with plenty of air will reduce not only the smoke, but also the fuel bill.

A certain amount of smoke from a power plant is as unavoidable as fleas on a dog, especially with fluctuating load. Many of the ordinances have been framed with this fact in mind and smoke of moderate density is permitted for periods of from four to fifteen minutes each hour, according to the diameter of the stack and the class of service, steamboats and locomotives being given the greatest latitude. Inspectors, armed with cameras, are employed to report noncompliance with the law and exact the fine. If half the time expended in trying to outwit the inspector were utilized in legitimate smoke prevention, the fuel bill, at least, would be the gainer.

Smoke is a nuisance in the eyes of the law and any reasonable ordinance intended for its abatement will be sustained by the courts. When the dirt that it creates and the discomfort that it causes become intolerable, the sufferers appeal to the lawyer for relief and drastic legislation sometimes ensues. This may be obviated by a little care and foresight on the part of the stationary engineers if they will but anticipate this inevitable effort for civic betterment by drafting and urging reasonable legislation. In other words, they should not leave to lawyers and politicians the regulation and even operation of their power plants.

PERSONALS.

Frank H. Ray of New York is at San Francisco.

F. F. Skeel, manager of Crouse-Hinds Company, is visiting the Pacific Coast.

M. C. Lord of Heald's College of Engineering, left this week for Seattle.

H. R. Noack, of Pierson, Roeding & Co., is in the mountains of Plumas county.

F. C. Ambridge has been appointed general auditor of the Fresno Traction Company of Fresno.

H. C. Rogers, the Denver manager for the Westinghouse Machine Company, is visiting San Francisco.

Seton Porter, of Sanderson & Porter, of New York, will spend a month or two at the San Francisco branch office.

F. A. Richards, manager of the car department of Pierson, Roeding & Co., returned last week from a Northwestern tour.

A. F. Hockenbeamer, second vice-president of the Pacific Gas and Electric Company, has returned from an extensive Eastern trip.

H. W. Noething has resigned as chief engineer of the Union Brewing & Malting Company of San Francisco, after seven years' service.

A. J. Meyers, Pacific Coast manager for the Wagner Electric Manufacturing Company of St. Louis, has returned from a northern trip.

O. A. Schlesinger, who was at one time with the Westinghouse Company, has joined the sales force of the Pacific States Electric Company.

W. W. Briggs, Pacific Coast manager for the Westinghouse Electric & Manufacturing Company, has gone to the mountains on a vacation trip.

Chas. Wiggin is in charge of the Los Angeles office of John R. Cole & Co., while Geo. Cole, the Los Angeles manager, is visiting San Francisco.

W. S. Heger, Pacific Coast district manager for the Allis-Chalmers Company, has returned from a trip to his Los Angeles office, where business has been excellent during the past month with good prospects.

K. G. Dunn, engineer with Hunt, Mirk & Co., representing the Westinghouse Machine Company on the Pacific Coast, has returned from a trip to Pittsburg.

C. H. Heilbron, a vice president of the California State Association of Electrical Contractors, came up from San Diego to attend the annual convention at the Palace Hotel.

R. C. Gilles, vice-president of the Mt. Hood Railway & Power Company of Portland, has been elected president of the Los Angeles-Pacific Company, succeeding E. C. Clark, resigned.

W. B. Woodill of Los Angeles, who is a vice president of the California State Association of Electrical Engineers, arrived the first of the week to attend the annual convention in San Francisco.

Paul Shoup, assistant general manager of the Southern Pacific Company, in charge of electric lines, went to Southern California last week on business connected with the taking over of the Fresno Traction Company.

A. G. Wishon has resigned as manager of the Fresno Traction Company, but will retain the management of the San Joaquin Light & Power Company and the Fresno City Water Company. He is succeeded in the traction company by F. W. Webster.

H. H. Noble, president of the Northern California Power Company, left last Tuesday for an inspection tour of his hydro-electric plants in Shasta and Tehama counties. He was accompanied by E. V. D. Johnson, the manager of the company, with headquarters at Redding.

N. A. S. E. HIGH JINKS.

California No. 1, N. A. S. E., will give a smoker and midsummer high jinks on July 14th at their hall, 172 Golden Gate avenue, San Francisco. A general invitation has been extended to many engineering societies to attend this meeting.

Newly elected officers of California No. 3, N. A. S. E., are: President, C. E. Van Meter; vice-president, C. M. Irwin; recording secretary, John Ostrom; financial secretary, Charles Knight; treasurer, Charles Dick; guide, W. G. Tallbot; trustee, Wm. P. Millner; doorkeeper, John Hanna.

The new officers of California No. 1, N. A. S. E., as elected on June 30, 1910, are: President, P. L. Ennor; Vice-President, J. T. Stewart; Corresponding and Recording Secretary, C. H. Reinoehl, 73 Sharon Street; Financial Secretary, J. M. Wilson; Treasurer, Daniel Daniels; Conductor, D. A. Richardson; Doorkeeper, H. L. Gaskill; Trustees, Chas. Magnin, J. W. Maher, L. H. Honigbaum; Delegates to the National Convention to be held at Rochester, N. Y., Chas. Bankey, F. B. Dunn, H. L. Gaskill, and Wm. H. Kearney; Alternates to the National Convention, H. W. Noethig, J. W. Maher, J. T. Stewart and P. L. Ennor; Delegate to the Life and Accident Insurance Department, Wm. H. Kearney; Alternate to the Life and Accident Insurance Department, H. W. Noethig.

CONTRACTORS' STATE CONVENTION.

The annual convention of the California Association of Electrical Contractors opened at 10 a. m., Tuesday, July 5th, in the Music Room of the Palace Hotel, with President W. S. Hanbridge in the chair. Other officers of the organization present were H. B. Woodill, first vice-president; C. H. Heilbron, second vice-president; F. V. Meyers, secretary, and E. C. Wakeman, sergeant-at-arms. The attendance on the first day was small and the committee on credentials found that the 155 members throughout the State were represented by proxy by about 20 members actually present.

The opening address by President Hanbridge and the preliminary work of organization took up most of the first day. Out of the nine local districts of the State eight were represented by their officials.

The reports of various committees on routine matters were adopted.

Secretary Meyers reported that the financial condition of the Association was satisfactory. The discussion of subjects of importance to the contracting business occupied the remainder of the morning session.

At the afternoon session the reports of committees appointed at the last convention and at a meeting of the directors of the Association held at Santa Barbara in April, 1910, were heard and adopted.

During the afternoon the ladies accompanying the members from outside cities were given an automobile trip by San Francisco District Local No. 1.

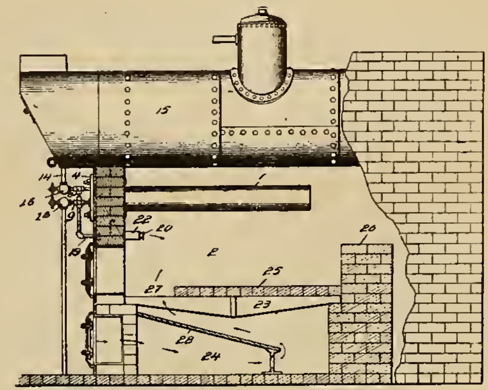
At 7 p. m. an elaborate banquet was served to members and invited guests in the large banquet hall of the Palace Hotel. Several entertaining speeches were made and the usual toasts were proposed, while the best of harmony prevailed.

Wednesday, July 6th, was devoted entirely to entertainment. San Francisco District Local No. 1 chartered the steamer Sehome for the day and arranged for the serving of luncheon on board. A large number of guests, including members of the State Association and their ladies and friends, embarked at the Clay-street Wharf and made a steamer tour around the bay and up the Sacramento River as far as Rio Vista, making brief stops at points of interest.

On Thursday business was resumed and the remainder of the usual routine was carried to a successful completion with a greatly augmented attendance such as it was impossible to secure on the opening day.

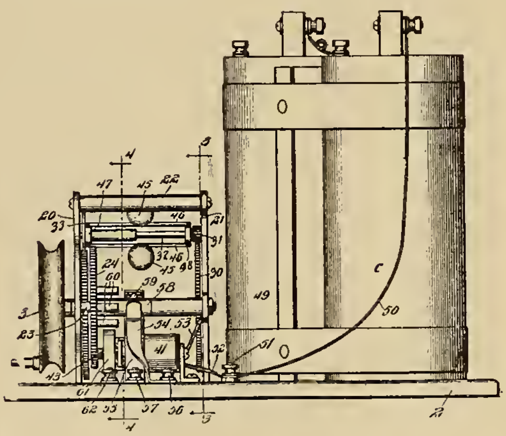
PATENTS

962,971. **Burner.** George J. McPherson, Salt Lake City, Utah, assignor, by direct and mesne assignments, to International Oil Gas Producer Company. An oil burner of the class described, comprising a superheating retort, a steam supply pipe extending thereinto and discharging at the inner end



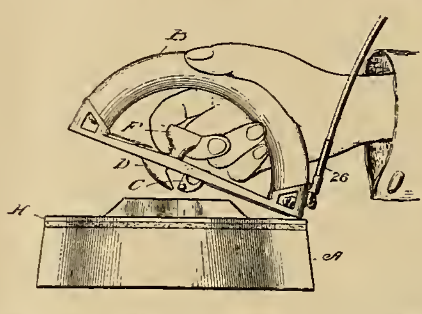
thereof, a gasifying retort located within the steam superheating retort, a feed pipe for liquid hydrocarbon extending into and discharging at the inner end of the gasifying retort, a mixing duct and connections between said mixing duct and said retorts to cause the superheated steam and gases to become commingled to produce a combustible mixture.

962,884. **Thermo-Electric Furnace-Regulator.** James H. Bobbitt, Harvard, Neb. In an apparatus of the class described, the combination of a thermostatically actuated circuit closer responsive to predetermined maximum and minimum temperature conditions, circuits connected with the said closer, draft regulating devices, and a motor mechanism controlled by the said circuit closer for operating the draft devices; said motor mechanism comprising a frame, a shaft mounted thereon, a wheel secured to the shaft, a weight-cord device for turning the wheel, a connecting element between the wheel and the draft devices, a contact finger mounted on



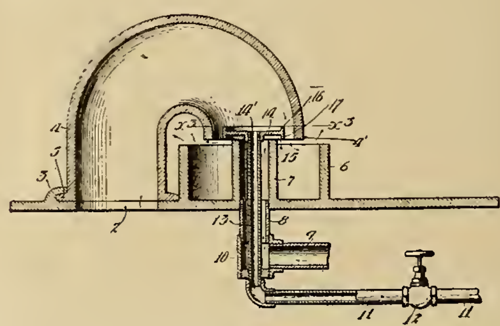
the shaft to rotate therewith, spring contacts with which the contact finger is adapted to engage, a brake disk, a shaft supporting the same, a train of gears between the shafts, a governor on the second mentioned shaft, and connected with the brake disk, means for rotating the governor from the first mentioned shaft, a brake shoe arranged to engage the disk, a lever mounted to release the brake shoe, an armature connected with the lever, an electromagnet arranged opposite the armature and adapted to be connected in circuits when the circuit closer is closed and the contact finger is in engagement with either spring contact.

962,768. **Electric Sad-Iron.** Henri G. Levy, San Francisco, Cal. In a device of the character described, the combination of a body portion and a removable handle therefor, said body portion having an electric-heater within it, and provided



with contacts, and said handle portion having contacts adapted to establish an electrical circuit through the first-named contacts and heater co-ordinately with the application of the handle to the body portion.

962,695. **Oil-Burner.** Roland C. Casad, Covina, Cal. An oil burner comprising a plate formed with two openings, a bent tubular member having one end communicating with one of said openings to receive air from beneath the plate and having the other end directed downwardly above the plate to form an air outlet, an oil supply pipe extending through the other of said openings in the plate, a head formed with an oil cup at the upper end of said oil supply



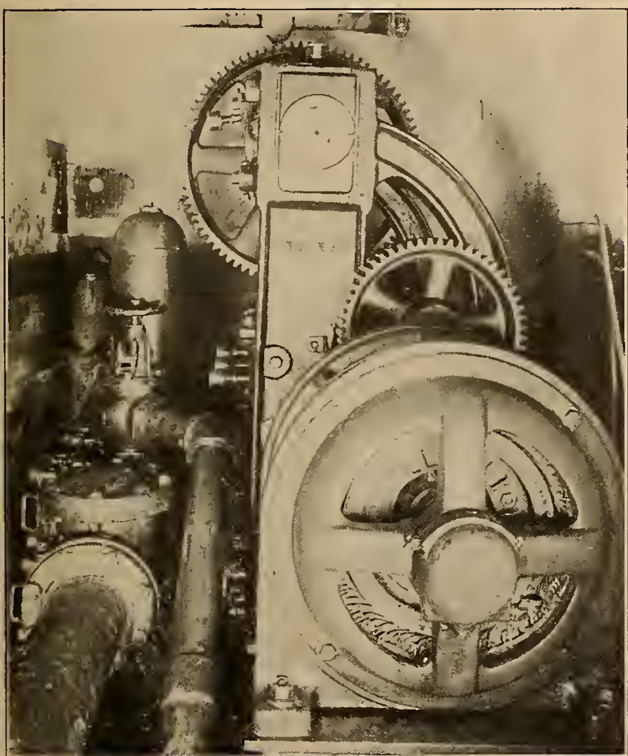
pipe and communicating therewith, said head extending within said air outlet and being of greater diameter than said oil supply pipe, and a second tubular member surrounding said oil supply pipe and extending beneath said oil cup, said second tubular member communicating with said other opening in the said plate to receive elastic fluid therethrough, whereby said elastic fluid is directed at the inside of the oil or vapor passing from the oil cup and the air from the aforesaid air outlet is directed at the outside of said vapor.

962,651. **Sea Power-Generator.** Robert Max Mobius, San Diego, Cal., assignor to F. K. De Borde, San Diego, Cal. A device of the character described, comprising a platform mounted upon piling, bearings on the platform, a pendulum frame swinging from said bearings, a vertically adjustable panel mounted in the frame, means for securing adjustment of the panel comprising a cable, a drum over which the cable passes, a crank for winding the drum and a pawl engaging the shaft of the drum, and chains in combination with sprocket wheels and pulleys.

INDUSTRIAL

REMARKABLE PERFORMANCE OF INDUCTION MOTOR.

A 20-hp., 3-phase, 220-volt standard induction motor made by the General Electric Company recently demonstrated the ability of the standard motors manufactured by this company to operate successfully under the trying conditions met with in mines where the air is very damp, without their being totally inclosed. This is of great importance, as thorough ventilation of the motor is absolutely necessary due to the high temperatures which prevail in mines. This motor is geared to a mine pump, located at the bottom of the shaft at the mines of the Richmond Iron Works, Richmond Furnace, Mass., and is installed in a chamber where the air is always very damp and moisture is continually dripping from



Standard General Electric Three-Phase Induction Motor Driving a Pump in Mines at Richmond Furnace, Massachusetts.

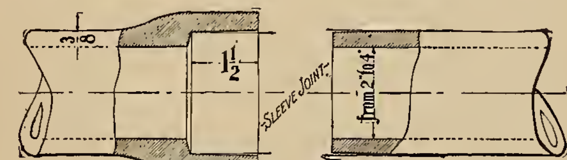
the roof timbers. It is protected from this water by a piece of tarred paper tacked above it, so as to conduct the water away.

During a heavy thaw last January, the surface water broke in on one of the upper levels and flooded the mine. The water rose so rapidly that the electric pump was soon under water, the top of the motor being two feet below the surface. Under such circumstances it was imperative that the pump should continue in operation as long as possible, and so it was not shut down. It continued to operate perfectly and at the end of two hours, during the whole of which time the motor was submerged under water, it had pumped itself clear of water. It was then stopped only long enought to clean the dirt and chips from around the rotor and put oil in the bearings, and then was started up again. This pump has been running about 20 hours a day ever since and the motor has apparently suffered no injury from its unusual experience.

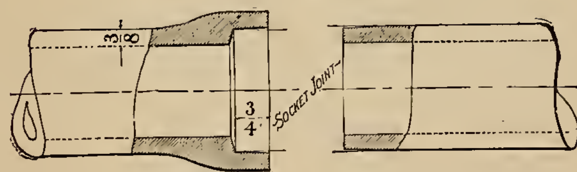
A NEW CONDUIT FOR UNDERGROUND CABLES.

A new cable conduit recently placed on the market by the H. W. Johns-Manville Co., New York, known as J-M Fibre Conduit, is especially noteworthy because of some features new in the manufacture of conduit. This conduit is made of indurated fibre, a material which has been used very extensively for insulating purposes, such as third-rail coverings, controller linings, battery boxes, etc.; water pails, etc., have also been made of it for many years.

In making J-M Fibre conduit, the fibre is moulded into shape under high temperature and immense pressure, and is entirely without grain or laminations. This process gives each length of conduit a solid ⅜-in. one-piece wall-homogeneous—with tensile strength that is remarkable when compared with the light weight of the conduit.



J-M Conduit Socket Joint.

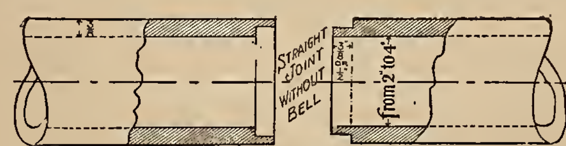


J-M Conduit Sleeve Joint.

But the most interesting feature of this new conduit lies in the bell joints shown above. One end of each section is moulded to an enlarged size—belled out—with an opening as large as the outside diameter of the opposite end of the next section. Thus, any two sections fit together without any reduction in the wall thickness of either section at the joint. This makes a stronger and more rigid connection than is possible with any other kind of joint.

In laminated fibre conduit, half the wall thickness at the ends of each length must be cut away in order that one length may fit or screw into the other. And that reduces the strength of the joint by half.

Realizing, however, that installation methods on some systems have been devised which necessitate the use of straight joints, the manufacturers have also arranged to make this new conduit with straight line joints, as shown below.



J-M Conduit Straight Joint.

The joints in this new conduit are perfectly smooth inside—they are machine moulded—perfectly true—no offset. And each length of the conduit is also smooth throughout its bore. This greatly facilitates the work of inserting cables.

The manufacturers claim that by reason of there being no seams or roughness at the joints of this conduit and as the air-tight joints prevent particles of concrete from seeping through, a No. 6 wire can be pushed through each duct from manhole to manhole, doing away with the ropes and rods so necessary with ordinary conduits.

Moreover, the smooth, tight joints and the smooth bore of this conduit should add greatly to the life of cable for the seams or raw edges at joints, burns, blisters, lumps, etc., are ordinarily the greatest cause of cable trouble as they injure or abrade the lead casing of cable when it is being drawn through the duct.

Tests made of this conduit with ⅜-in. thickness of wall show that it has an average puncture voltage of 40,800 dry and 33,000 volts after 40 hours immersion in water. Danger of electrolysis should therefore be practically eliminated by the use of this conduit.

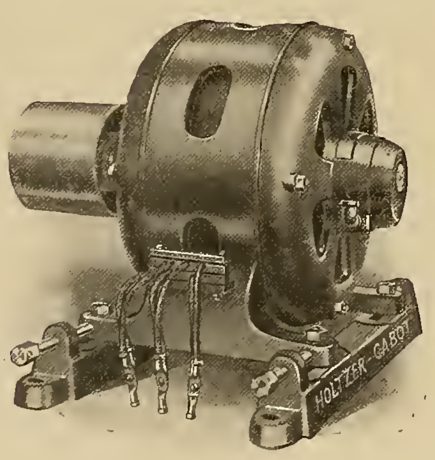
In weight, this conduit has an advantage over those made of stoneware, etc., as it weighs only about one-sixth as much. This makes it easier to handle. The light weight also cuts down the freight charges, which is especially noticeable when laying at a considerable distance from the railroad unloading point or from storage point. Breakage is also reduced to a minimum with this conduit by reason of the great tensile strength of its walls.

A variety of fittings such as bends, elbows, tees, etc., provide for bends and curves in the trenches. Two, three and four way junction boxes provide for branch and service connections. An attractive booklet has been gotten out by the manufacturers, and a copy can, no doubt, be obtained by writing to the H. W. Johns-Manvile Co., New York.

HOLTZER-CABOT POLYPHASE MOTORS.

In putting upon the market a line of polyphase induction motors, The Holtzer-Cabot Electric Co. does not in any sense pass through an experimental period, since its long experience in the more difficult design of single phase motors has enabled it to produce a particularly efficient line of polyphase motors.

These motors have been generously designed in all points where generosity counts. Their overload capacity, starting torque, heating, bearings, etc., are more liberal than



10 H.P. Holtzer-Cabot 3-Phase Motor.

is indicated by ordinary practice. They have been designed to start and carry heavy overloads, but at the same time good efficiencies and power factors have been reached. Close attention to details has produced machines having to a large extent all these desirable features.

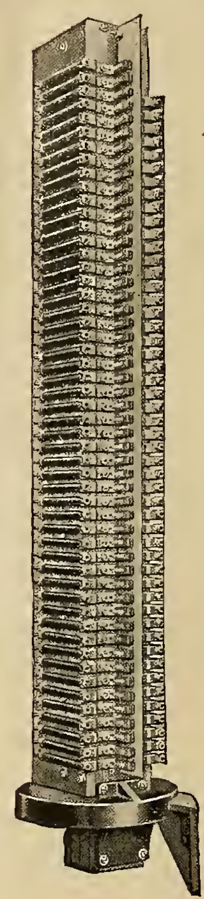
It has been recognized, however, that mere size and weight do not make good motors. Accordingly particular attention has been given to produce rugged and highly efficient motors of moderate overall dimensions. This enables them to be successfully used in many places where space is limited.

In mechanical construction these motors follow the conventional design which world-wide experience has proven best suited to polyphase apparatus. Particular attention has been given to producing good ventilation, and therefore cool running, by the use of revolving vanes. High power factor and good starting performance is assisted by the use of partially closed slots in all sizes; the slot opening being left large enough, however, to permit the easy removal of coils in case of trouble.

These motors are built for constant speed in sizes from one-half to 30 horsepower, and for all commercial voltages, frequencies and speeds. Compensator starters are ordinarily furnished with the larger sizes; although where the starting torque required is not great, primary resistance starters may be used, thus somewhat reducing the cost of the apparatus.

NEW PROTECTED TERMINAL CABLE.

A new cable terminal which has recently been placed on the market is designed to replace two of the older types of cable terminals, namely: the compact, hooded, but unprotected type, and the cumbersome wooden-box protected



Protected Cable Terminal with Cover Removed.

No. 18 Cable Terminal with Cover Partly Removed for Inspection of Fuses.

terminal. This new terminal, the Western Electric Company's No. 18, combines all of the advantageous features of design of those two older types. It is a compact, weatherproof device which affords protection to the central office equipment against lightning discharges and accidental contact with power wires.

The No. 18 protected cable terminal consists essentially of a rectangular oiled and shellaced wooden box into which the cable is led. Two sides of this box serve as mountings for the fuse clips and as fanning strips for the bridle wires. The third side acts as a support for cut-outs. During manu-

facture the interior of the box is filled with water-proof pot head compound, which fills all spaces between the fanned-out wires and seals the end of the cable against moisture. The box is mounted on a cast iron base, or bracket, in the center of which is fitted a wooden bushing for clamping the cable in place and relieving the wires of all strain.

The cable chamber, binding posts and connections are protected against weather by a heavy reinforced, galvanized sheet-iron hood which may be lifted to any height necessary to examine the fuses, etc. The hood is held at the desired height by a spring latch mounted on top of the fanning strips. However, should the hood be removed completely it will be prevented from falling to the ground by a non-corrosive sash-chain which attaches it to the bracket.

The protective devices supplied consist of fuses and open-space, carbon-block, cut-outs, two of each wired into each pair of wires, the cut-outs being connected between the fuses and the cable.

The Western Electric Company manufactures this type of protected terminal for use with No. 22 gauge wire, paper insulated, lead-covered cable in capacities of from 10 to 60 pairs of wires.

Ordinarily the terminal is supplied with a six-foot cable stub which is spliced to a cable of sufficient length to make the connection desired. However, where possible the terminal should be ordered with a cable of the required length, thereby eliminating one splice.

ELECTRIC VEHICLE PUBLICITY.

The Electric Storage Battery Company of Philadelphia has successfully launched one of the most comprehensive advertising campaigns ever undertaken to popularize the electric vehicle. The two directly interested parties in this publicity scheme—the central station managers and the electric vehicle manufacturers—have been shown the enormous advantage which would result in joining hands with the battery company to advertise on a very large scale the superior merits of the electric vehicle.

They have cordially endorsed the plan and the funds which they have contributed are to be expended in larger advertisements in magazines of national circulation—the intention being to lay before the public in an educational and graphic manner every week the real supremacy of the electric as a city and suburban pleasure and commercial vehicle.

The electric vehicle manufacturers have been large advertisers of their own product but this publicity is to be impersonal and one which means increased business to all parties concerned; The Central Station people are alive to the fact that it brings a permanent source of revenue to them. The work of laying out this campaign is being done by The Electric Storage Battery Co. That it has successfully wrought out this comprehensive and well thought out scheme is a matter of congratulation to all who have taken part.

NEW CATALOGUES.

Catalogue No. 8 from the Ohio Brass Company, Mansfield, Ohio, comprises an exhaustive compilation of standard types, forms and sizes of materials for electric railways, mine haulage systems and transmission lines.

Bulletin No. 4739, issued by the General Electric Company, describes the GE MAZDA incandescent lamp which has an improved tungsten filament and gives the high efficiency of 1 to 1¼ watts per candle. The bulletin describes this lamp in great detail, and illustrates the various sizes of this type of lamp for use on multiple circuits. It contains tables showing cost of operation and life, effect of voltage variation on candle-power and watts, relative costs of lighting with various lamps for equal illumination, etc., etc. It also devotes considerable space to the reflectors necessary to give the best results.

APPROVED ELECTRICAL DEVICES

RECEPTACLES, FOR ATTACHMENT PLUGS.

Surface Receptacles, Cat. Nos. 5617-5620 incl., 10 A., 250 V., with plugs 5419-5421 incl. Cat. Nos. 5621-5623 incl., with plug 5553, 20 A. 250 V. Flush Receptacles, Cat. No. 5547 with plugs 5419-5421 incl., and Cat. No. 5566 with plug 5567, 10 A. 250 V., Cat. No. 5552 20 A. 250 V., with plug 5553, 20 A. 250 V. Conduit Box Receptacles, Cat. Nos. 5614 and 5624, 10 A. 250 V., with plugs 5419-5421 incl. Approved March 4, 1910. Manufactured by

Hubbell, Harvey, Inc., Bridgeport, Conn.

RECEPTACLES, STANDARD.

"Bryant 3 A. 250 V." Sign, Cat. Nos. 1700, 40488, 46749 and 59108. Also "Ruby" 102717 when installed so that both the porcelain base and the metal rings are held by means of solder so that they cannot turn in the sign face. Cleat, Cat. Nos. 9402, 9403, 921, 1011, 1123, 50715, 11221, 28795, 54949 (formerly 23209), 58300 and 58301 (formerly 23210). Concealed, Cat. Nos. 50744; also 9447, fusible 2 A. 125 V. Moulding, Cat. Nos. 42453, 58302 and 58950 (formerly 34152). Conduit Box, Cat. Nos. 9514, 9397, 40507, 40537, 59107, 62357, 62355 and 62356. Approved Feb. 28, 1910. Manufactured by

The Bryant Electric Company, Bridgeport, Conn.

"T. E. M. Co." 3 A. 250 V. Conduit Box Receptacle, Cat. No. 976. Approved Feb. 9, 1910. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

"C. S. K." 3 A., 250 V. Conduit Box Receptacle H. K. No. 3. Approved March 15, 1910. Manufactured by

C. S. Knowles, 7 Arch St., Boston, Mass.

RHEOSTATS.

Motor starting rheostats described in Bulletins 11B, 11C, 11D, and 12B ¼-30 H. P. 125 and 240 V.: ¼ to 50 H. P., 500 V. Approved March 15, 1910. Manufactured by

Union Electric Mfg. Co., Milwaukee, Wis.

SWITCH BOXES.

"Fancleve" cast iron switch boxes. For metal conduit, Cat. Nos. 351, 501. For flexible tubing, Cat. No. 651. For wooden moulding, Cat. No. 201 (Universal switch or junction box) and Cat. No. 402 (supporting box for surface snap switches). Approved March 4, 1910. Manufactured by

Fancleve Specialty Co., Jamaica Plain Station, Boston, Mass.

SWITCHES, COMBINATION CUTOUT.

Porcelain base switches with Edison plug cutouts, Cat. Nos. 701, 703, 721, 723 and 727 30 A., 125 V. Panel cutouts, Cat. Nos 714 to 719 inclusive, 15 A., 125 V. Porcelain base switches with cartridge fuse cutout, Cat. Nos. 704, 705, 724 and 725, 30 A., 250 V. Approved Feb. 28, 1910. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, KNIFE.

Type A, 250 and 500 V., all capacities, with or without N. E. Code standard cartridge enclosed fuse extensions. Type C, 0-300 A., 250 V., with or without N. E. Code standard cartridge enclosed fuse extensions. Approved March 9, 1910. Manufactured by

Agutter-Griswold Co., 411 Occidental Ave., Seattle, Wash.

SWITCHES, SURFACE SNAP.

"Perkins" 600 Volt Switches, single pole, 5 and 10 amperes. Approved Feb. 16, 1910. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

C. E. M. Co., 3 A., 250 V. Conduit Box, Cat. No. 1225. Cleat, Cat. No. 9402. Sign, Cat. Nos. 1700 and 977. Approved March 1, 1910. Manufactured by

Connecticut Electric Mfg. Co., Bantam Connecticut.

NEWS NOTES

INCORPORATIONS.

HAVRE, MONT.—The Havre Electric Steam Heat & Telephone Company has been incorporated for $200,000 by C. C. Swinbourne.

VANCOUVER, B. C.—The Vancouver, Camas and Washougal Traction Company has been incorporated by H. C. Phillips with a capital stock of $100,000.

SAN FRANCISCO, CAL.—The Sunset Power Company has been incorporated by C. B. Greeley, W. L. Boos and Thos. Turner with a capital stock of $500,000.

ELLENSBURG, WASH.—The Electric Power Company has been incorporated by J. C. Donnelly and H. J. Manny of Tacoma, with a capital stock of $1,000,000.

EUREKA, CAL.—The Del Norte People's Telephone Company has been incorporated by one hundred and twenty-five merchants of Humboldt county, with a capital stock of $10,000.

SAN FRANCISCO, CAL.—The Bay Cities Home Telephone Company has been incorporated by James Lanagan, Guy Knupp, H. T. Bailey, C. F. Moeler and others with a capital stock of $20,000,000.

BELEN, N. M.—The Belen Light & Power Company has been incorporated by W. M. Berger, Oscar Goebel and Mary E. Berger of New Mexico and Chas. Henry Schull of Los Angeles with a capital stock of $25,000.

FINANCIAL.

ROSEVILLE, CAL.—At the special election held here the people approved the issue of $90,000 bonds for the installation of a sewer system and an electric light and power plant.

ASHLAND, ORE.—Ashland voted $55,000 improvement bonds at a special election; of this $25,000 is to complete the municipal electric light and $30,000 for paving street intersections.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company, which is supplying power for the operation of the United Railroads in this city, has authorized the issuance of $6,500,000 of first-mortgage 5-per-cent bonds for the purpose of enlarging its plant and so extending its facilities that it may be enabled to supply intending purchasers with all the power required.

SAN FRANCISCO, CAL.—The Supreme Court has handed down a decision in the Geary street bonds case, in which every point made by the city is sustained, and the way is paved for the sale of the bonds. The decision declares that the course of the city officials in the matter has been regular and construes the city charter and the State Constitution in such a way that no question is left as to the city's right to construct, complete or purchase a municipal street railway system.

TRANSMISSION.

SAN FRANCISCO, CAL.—The Mariposa Electric Power Company has filed application in the Superior Court for voluntary dissolution.

HAMILTON, MONT.—S. R. Inch of the Missoula Light & Power Company, has been granted permission to construct a high power tension transmission line along the public roads of the valley.

LA BARRANCA, SONORA.—The Sunset Mining Company, a subsidiary of the Southern Pacific is now drawing up plans to put in a large power plant and sell power to surrounding mines and hamlets.

SANTA ROSA, CAL.—Manager Thomas D. Petch of the Santa Rosa Branch of the Pacific Gas and Electric Company, has received orders for the construction work involving the laying of 12 miles of new 2-inch gas pipe, and two miles of ¾-inch pipe. The new work will be begun as soon as the material can be secured.

CLARKSTON, WASH.—The Grande Ronde Water & Power Company of this place, recently organized with a capital of $1,000,000, has started on the survey for its proposed power plant on the upper Grand Ronde river. The river at the point or site of the plant is capable of producing 30,000 horsepower.

KLAMATH FALLS, ORE.—J. Lewis and G. McDonald arrived in this city from Lakeview where they have looked after the development of a new power plant for which they have the rights on Deep creek, about 22 miles east of Lakeview. It is estimated that 7000 horsepower can be developed. Work is to commence this summer.

LAS VEGAS, NEW MEX.—Incidental to taking over the Las Vegas Light & Power Company, and Las Vegas Transit Company by the Federal Light & Traction Company of New York, a corporation which is being formed for control of numerous light and power companies in Colorado, New Mexico, Arizona and Wyoming, it is said that two local companies will be extended and enlarged. Their line will also be extended to Hot Springs.

EL PASO, TEX.—The El Paso Electric Railway Company has filed a certificate of increase whereby the capital stock of the company is increased from $1,500,000 to $2,500,000. Some of the improvements to be taken care of by the addition of one million dollars to the operating capital of the company is the extension of the smelter line to the cement plant and the enlargement of the power plant to more than double its present capacity and the purchase of new cars.

REDDING, CAL.—The Sierra Nevada Power & Irrigation Company has filed three complaints in the Superior Court of Shasta County against the Central Pacific R. R. Co. and others, to condemn rights of way for a ditch and power line, and to quiet title to riparian rights of landowners on Montgomery Creek, Hatchet Creek and Roaring Creek. The irrigation company was incorporated April 19, and to purchase it has acquired water rights for a total of 15,000 inches, 5000 inches on each side of the three creeks mentioned. The three creeks run into Pit river where the company proposes to construct its power-house. In order to bring the water of the three creeks together at the powerhouse the company must have rights of way for its flumes and ditches. The question of condemning riparian rights is involved in the actions.

OROVILLE, CAL.—Charles Swezy, an attorney of Sacramento, has filed an appropriation of 20,000 inches of water. Of this amount of water 10,000 inches are taken from the water of Mosquito Creek and 10,000 inches of the water of French Creek. The filing was made in the name of Annie Swezy. The purpose of the appropriation are named as irrigation and power. The water will be taken from Mosquito Creek at a point one mile from its junction with French Creek. The water of French Creek is located at a point

above the junction of the two streams. The notice states that the water of Mosquito Creek will be diverted by means of a dam 15 feet high made of concrete and 40 feet wide. On French Creek it is proposed to build a dam ten feet high and 50 feet wide. The water will be carried in ditches 12 feet wide at the base to the power house. The appropriations do not state the location of the power house. From the locations stated, however, it is presumed that the power house will be west of the Berry Creek Hotel.

ILLUMINATION.

SAN BERNARDINO, CAL.—Plans are being drawn for an electric light plant to be installed by the Barstow Utility Company.

OAKLAND, CAL.—The building committee of the Supervisors has been authorized to install a permanent electric and power plant in the new county jail.

KLAMATH FALLS, ORE.—Frank Smith has made application tc the Council for a franchise for the installation of a gas plant. He proposes to manufacture the gas out of the garbage of the city.

OAKLAND, CAL.—On the recommendation of City Electrician Babcock it has been ordered that hereafter the tungsten lamps shall be installed and the arc lights gradually eliminated.

FRESNO, CAL.—With the completion of the two freight sheds for the Southern Pacific by August 1, it is reported that the men there will soon after be engaged in erecting a private power plant near the round house for supplying the depot and yards with electric current for illumination.

CENTRALIA, WASH.—The Twin City Light & Traction Company has let the contract for a $150,000 power plant to be located at Coal Creek, about four miles southeast of Centralia, the plant to furnish power for the electric cars besides all the power needed for the lighting and commercial purposes of Centralia and Chehalis. The plant is to be completed in about three months.

DUNSMUIR, CAL.—The Siskiyou Electric Light & Power Company has acquired all the electrical holdings of the Mossbrae Falls Light & Power Company, and hereafter will be the sole occupant of this field. The purchase was effected on Jnue 15th. The Mossbrae power plant will be abandoned, the new company having abundant power of its own, and the poles and wire of the old company will he taken down.

SAN FRANCISCO, CAL.—The Commissioners have awarded to the Mutual Electric Light Company the contract for furnishing current for light, power and other purposes in the Ferry depot and along the waterfront for the next three years. The Mutual company's bid was $1.25 per week for each arc light of 2000 candle power and a rate of .0275 per 1000 watt hours for electric current for other lights, power and other purposes.

LOS ANGELES, CAL.—The plant of the West Side Electric Company at Maricopa will be enlarged greatly and power and lights will be furnished in adjacent oil fields, Taft and Moron as well as Maricopa. H. C. Shippee, president and general manager of the company, which has offices in H. W. Hellman Building, has just returned from an extended trip to the East, where he has arranged to finance the proposed extension of the company's plant.

PENDLETON, ORE.—The Pacific Power & Light Company, with a capital stock of $7,500,000, has been formed. The work of organization was done by the American Power & Light Company of New York, which already owns the Portland Gas & Coke Company. F. Sykes and S. Z. Mitchell, former Portland residents are respectively president and chairman of the board of directors, and G. Talhot of Portland is the vice-president of the American Power & Light Company. The officers of the Pacific Company are not yet announced. The new concern plans a system of power development in the Pacific Northwest and will cover the Columbia, Yakima, and Walla Walla Valleys with its transmission lines and distributing system.

TRANSPORTATION.

OREGON CITY, ORE.—The Portland Railway, Light & Power Company will build a branch from West Oregon City to Oswego.

GLENDALE, CAL.—An electric street railway franchise on Glendale avenue north of Third street has been awarded by the City Trustees to E. D. Goode.

POMONA, CAL.—The City Council has passed an ordinance granting to G. E. Pillsbury a franchise to construct and for a period of 50 years to maintain and operate an electric railway in the public streets of Pomona.

OAKLAND, CAL.—The San Francisco, Oakland and San Jose Railway Company has contracted with a general railway signal concern of Rochester, N. Y., for the installation of a complete signal system at its terminals.

VENICE, CAL.—It is announced that President Gillis of the Los Angeles-Pacific has obtained from New York full authority to go ahead with the proposed four-tracking of the line between Venice and Redondo.

REDLANDS, CAL.—General Manager Merrihew has announced that he is to go to Redlands to represent the San Bernardino Valley Traction Company in a conference over a petition for an extension of an electric line to the University of Redlands campus.

SANTA MONICA, CAL.—Early next month the new management of the Los Angeles-Pacific Railway Company will begin the improvement of the entire system. Five hundred men are to be put to work reballasting the lines with crushed rock. All light rails are to be replaced by heavier steel and new and heavier switches are to be put in.

SAN RAFAEL, CAL.—In executive session the town trustees instructed County Surveyor George L. Richardson to visit San Francisco and gather data on its street railway system for the purpose of making a report at the next regular meeting in connection with the petition of W. L. Courtright for a franchise to operate an electric road in the town limits. This is regarded as the first definite move toward the construction of a street railway. Courtright's plan is the prelude to a campaign which has been launched by capitalists and businessmen of Novato, San Rafael, San Anselmo, Kentfield, Larkspur, Ross and Corte Madera to raise $125,000 to begin building a street railway from Novato through San Rafael and Ross Valley towns to Corte Madera. It is estimated that $65,000 must be raised to float bonds for the proposed road.

OAKLAND, CAL.—The Peninsula Railroad Company, an allied corporation of the S. P., which was recently granted a street railway franchise by the City Council, has done its first work under that instrument on Twentieth street. This was done upon the request of the city street department in order that the new asphalt pavement, which is being laid on upper Broadway, may be put down permanently. The railroad is installing a crossing over the lines of the Oakland Traction Company. The rails are being laid from Twentieth street across Broadway and will be extended east and west when the installation of the line is completed. Under its franchise, the Peninsula Railway Company proposes to operate an electric line over a loop running from the Fourteenth and Franklin street depot to the Sixteenth street depot of the Southern Pacific.

PROFESSIONAL DIRECTORY

HANFORD, CAL.—At the organization meeting of the Hanford and Summit Lake Railway Company, held in Hanford the following officers were elected: Chas. King, Hardford, president; Ralph W. Heins, vice-president, Santa Cruz; J. O. Hickman, Hanford, treasurer; Clifford McLellan, San Francisco, general counsel; John B. Rogers, San Francisco, general manager and chief engineer. C. E. Lilley, Santa Cruz, general land agent. The directors of the company authorized an issue of $500,000 of five per cent, 30-year gold coupon bonds, interest payable semi-annually, of which $300,000 will be offered for general subscription to the public. These bonds will be secured by first mortgage on all the road and personal property of the corporation. The Old Bank was designed as the trustee for the purpose of carrying out the conditions of the deed of trust. The company will begin immediately the acquisition of the rights of way and will begin construction at the earliest possible date.

MARTINEZ, CAL.—An application for a franchise has been made by A. W. Maltby of the Oakland-Antioch Railway was discussed. Work on a part of the line over a private right of way has already been commenced near Walnut Creek. According to the engineers of the company the proposed road is to extend from Oakland to Martinez, passing through the inter-county tunnel and through Lafayette, Walnut Creek and Concord, a distance of 20 miles. It is proposed to operate the road by electricity and the Board of Supervisors of Alameda county has already granted the road a permit to use the tunnel upon the fulfillment of certain provisions. They relate to the lighting of the tunnel and to the safety of teams and pedestrians using the road through it. In discussing the building of the road, Maltby says that it means the greater development of the interior county, which is now reached only by wagon roads. The county is rapidly being developed, and it is the intention of the road to do a general freight and passenger traffic. The project is receiving the support of the commercial bodies of Contra Costa county, as it is proposed to run a line to Bay Point where the company has secured water front rights.

WATERWORKS.

CONDON, ORE.—A contract for putting in the meters for the city has been awarded by the Council to Jamison & Marshall.

COTTAGE GROVE, ORE.—The City Council has entered into a contract with the American Light & Water Company to construct a complete water system and pipe line from Laying Creek to this city.

SAN FRANCISCO, CAL.—The annual suit against the supervisors to prevent the enforcement of the rates established by them have been filed by the Spring Valley Water Company in the U. S. Circuit Court. The water company has been granted a temporary restraining order.

TURLOCK, CAL.—The Board of Trustees have passed an ordinance determining that the public interest and necessity demand the construction and completion of a more extensive water system for the purpose of providing additional facilities and means for furnishing water to the inhabitants of the City of Turlock.

HOLLISTER, CAL.—The San Benito Land & Water Company is surveying a site for a reservoir which is to be located about a half mile from Paicines. The reservoir is to cover an area of 160 acres and will have a capacity of 4000 acre feet. The water is to be taken from the Tres Pinos and San Benito rivers. The ditch, on which work has been commenced, is to connect with the present ditch which conducted water from the San Benito river about six miles south of Hollister. In order to connect the new reservoir with this old ditch about six miles of new ditch will have to be constructed.

ROSEBURG, ORE.—The Council has granted to the Douglas and Coos Power Company a fifty-year franchise to operate a water and light and power system in this city, work on which is to commence in two months after the granting of the franchise. The company is composed of C. Bell, F. Blakeley, F. Waito and W. Cardwell.

SAN JOSE, CAL.—A communication has been received from the San Jose Water Company stating its desire to erect a trestle across the Coyote creek to carry a six-inch water main from Fourteenth street, between San Antonio & San Carlos streets, to a main already laid in Franklin street, East San Jose, to provide an additional water supply for that town. The matter was referred to the River Improvement Committee.

SALINAS, CAL.—Certified copies of the amended articles of incorporation of the Soledad Land and Water Company and of the certificate of proceedings of the company have been filed with County Clerk T. P. Joy. The corporation has recently decided to diminish its capital stock from $30,000, divided into 1000 shares of $30 each to $18,600, divided into 620 shares of $30 each. The action was taken at a meeting of the directors and stockholders held in this city on May 28 last. The principal place of business of the corporation has been changed from Hollister to Salinas, and the company now operates a pumping plant as a private corporation, and not a public water service. The concern was organized within the past year, the five directors originally elected being N. C. Briggs of Hollister, B. F. Gould of Soledad; H. H. Tracey of San Francisco; H. N. Tracey of Hollister and Thomas Flint Jr. of San Juan.

OAKLAND, CAL.—The water-rate resolution establishing a 5-per-cent cut over the rates of last year went into effect yesterday without any contest on the part of the People's Water Company. The new rate will extend through the fiscal year 1910-11, and, although the water company hoped that the previous rate would prevail in the interest of much improvement work which is being planned. President F. A. Leach of the company says: "There will be no contest of the rates fixed by the City Council. The Council saw fit to reduce the rates according to the provisions of the agreement secured four years ago between the city and the water company. We, as a part of the agreement are ready to stand upon its terms. The company will take care of the future. We are working on plans for the development of the San Pablo dam and water sources. Whether we will carry out these plans or decide upon some other source has not been decided, but at present we are giving the San Pablo section the most serious consideration."

SAN FRANCISCO, CAL.—The Supervisors have passed to print a bill fixing the same water rates for the householder and the city for the ensuing fiscal year as were provided for the fiscal year nearing a close and reducing the toll to the shipping interests more than one-half. Under the new ordinance the shipowners who have been compelled to pay 75c for 1000 gallons of water will now have to pay about 32c. The scale under the new law is graduated, but in no case will it be over 66c, where before it was $1.50. Officers of the company say that the cut in favor of the shipping men will cost the corporation $50,000 a year and Supervisor Nelson, chairman of the water-rates committee, thinks that this amount will be increased to $70,000. According to the statement of representatives of the company application will be made for an injunction to prevent the enforcement of the new bill. This has been the proceeding heretofore and the excess demanded by the company has been placed in escrow by the Federal Court until such time as the questions involved have been determined.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 3 | SAN FRANCISCO, JULY 16, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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VOLUME XXV — SAN FRANCISCO, JULY 16, 1910. — NUMBER 3

DE SABLA AND CENTERVILLE POWER PLANTS

BY ARCHIE RICE.

Birdseye View of the De Sabla Power Plant on Butte Creek in Butte County, California.

Archie Rice

The black mule team sloshed through patches of snow. Towering pines stood sentinel-like along the lofty tableland. Forests and vistas of evergreen ridges on all sides suggested vast solitudes close up under the gray vault of the heavens.

Then the road descended and serpentined down and down. The sure-footed blacks never slackened their speed. We took the turns at almost a runaway rate. Each outer sweep close to the edge of the deep, sloping canyon brought its instinctive thrill. What might happen should an animal stumble, a wheel come off! The whole outfit would go tumbling, bounding, smashing, and mangling down, down, down, nearly a mile into the depths.

Five miles of that winding descent and we were finally at the bottom of the defile, but only a little more than a mile from the mountain lake up in the forest whence we had started.

A building gleaming silvery white clung on a blasted-out shelf at the edge of the stream. The surrounding brown and dense foliage greens and the varicolored rock strata of the precipices made this work of man stand out glaringly in a scene wonderful for its

natural picturesque beauty. No photograph can do it justice. The place is a bit of Switzerland with a touch of the Grand Canyon of Arizona.

The noise of thundering waters was akin to the incessant muffled boom and moan of the mighty Yosemite Falls. Spray-clouds rose out of the gorge by the silvery building and covered half an acre with mist like fine drizzling rain. But where was the waterfall?

Monster underground steel pipes coming 6000 feet down the slopes were carrying torrents of water from that mountain lake and shooting with tremendous force against water wheels under the building. The noise of waters, the rocketing and crashing were the escaping jets darting across and fighting and gradually conquering and loosening the granite masses of the opposite bank.

Here was the De Sabla power house. In that silvery building were being constantly generated 17,420 electrical horsepower, enough energy to maintain continuously and all together 260,000 electric lights of sixteen-candle-power each.

This was Butte creek, in the northern part of Butte County, in the northeastern part of California. All that thundering water flung into the stream was but a temporary loan. Down a little way a dam diverts it into a ditch and flume system that winds by a gentle descent for eight miles and then drops the water nearly six hundred feet perpendicularly through big steel pipes to propel wheels that generate 8576 electrical horsepower at another plant called the Centerville power house.

Then the creek finally receives the twice-worked water and goes winding meekly on down some twenty miles or more to make its contribution to the main river of the Sacramento valley. On flow those waters for many miles into San Francisco bay. They go out with the tide through the Golden Gate into the mighty Pacific. Abundant sunshine takes up the ocean moisture. The trade-winds waft the saturated atmosphere far inland. The towering white crests of the great wall of the Sierras check the clouds, chill them, and take tribute in myriad snowflakes to renew California's mountain streams and rivers. Nature in her bounty is nowhere wasteful.

California's inland rampart is the lofty wall of the Sierra Nevada Mountains. The slope is steep and high. It is gashed with streams that come down suddenly into the great interior valley. Heavy rains in the forest regions and melting snows in the summer maintain the flow of waters, and here and there man has built storage reservoirs to guard against the shortage of a possible dry season. Such are the conditions that have made California wonderfully rich in mountain water power, in matchless possibilities for hydro-electric development.

Way up toward the right-hand corner of the map of California is Butte County. It is an area larger than the state of Rhode Island. Its eastern edge follows the crests of the lofty Sierra. On the west it skirts the Sacramento river down in the great valley. But as a whole it is two-tenths mountains, heavily timbered; five-tenths foothills, rolling, piling slopes of partially bald or oak-timbered country; and three-tenths fertile valley lands, where grow the orange and the olive in great productiveness and where the rain seldom varies from an annual fall of twenty-five inches. The Feather river divides the county, and Butte creek, on which stand the De Sabla and Centerville electric power plants, cuts diagonally down across its northern third.

To reach these two power plants we went by rail to Chico, a community of about 12,000 people and the principal city of Butte County. Thence we climbed some 2500 feet up into the Sierras on the Butte County Railroad, winding gradually up and up, through Paradise and on to Magalia, where the mule team was to meet us. Magalia is a station near the top of a ridge, and the immediate outlook is down into densely forested canyons. Five miles away through the forest is Camp One, at the storage lake that supplies water to the hydraulic plants. But from the Centerville power plant we drove back to Chico by wagon road a dozen miles or more down along Butte Creek and then across the valley country.

Those two plants delivering their electricity into the same power line of three big aluminum wires at an intensity of 60,000 volts, supply many industries, light many towns, and send their subtle energy even to a distance of two hundred miles to communities about San Francisco bay.

The smaller plant at Centerville is the older one Back in 1898 the Butte County Electric Power Company was incorporated by O. W. Meysenberg, Judge J. A. Waymire, S. C. Dennison, H. B. Snow and C. C. Jones. Work was started at once on the proposed plant, but it was continued leisurely. In February of 1900 H. W. Heath became a director in the company and Park Henshaw, by reason of his large investment, was elected president. The power house was completed, and a transmission line to Chico was ready for service in May of 1900. The entire investment up to that time had been $175,000.

The plant started with two transmission lines in operation. One was to Chico, fourteen miles. The other was thirty-two miles to Oroville and the gold dredges on the Feather river. This gave a total transmission service of forty-six miles. In August of 1910 the line to Chico was continued down the Sacramento valley to Colusa forty miles. An independent line was also run from the power house to a junction with the Chico-Colusa line. Thus the system consisted of three main-line pole-lines from the power house, and all were of copper wire throughout, with an aluminum cable extension for the Oroville dredging district. Telephone lines were put on all the pole-lines and these telephone wires were transferred every tenth pole. When this power plant and the company controlling it were bought by the founders of the De Sabla system the Centerville power house was delivering four hundred kilowatts to Chico through two 200-kilowatt transformers, one hundred and fifty kilowatts to Gridley through two 75-kilowatt transformers, one hundred kilowatts to Colusa through two 50-kilowatt transformers, and about five hundred horsepower to the gold dredges on the Feather river.

Improvements and developments had been planned for the Centerville plant, but they were not made until after the transfer to the new ownership. The original

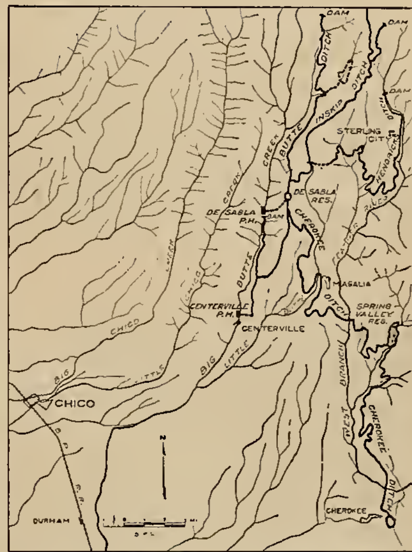
machinery was all mounted on heavy cast-iron floor plates set in masonry foundations. Soon after the larger concern had absorbed this plant it introduced extensive improvements, put in more machinery, added to the water-power, and generally increased the value and effectiveness of the property.

But how came the De Sabla power plant to be founded? I put the query to the man who conceived the idea of that development. He is a busy man, and I fired questions at him, and his stenographer recorded his words. Even in the secured privacy of his inner office important interruptions came at the rate of one every two minutes. Such is the complexity of the schemes that are handled by Eugene J. de Sabla Jr., the man who created the De Sabla power plant in 1903, founded the Nevada power plant near Nevada City back in 1895-6, and helped found and finish the great Colgate power plant in 1899.

Here is his story of why and how the De Sabla power plant came to be established:

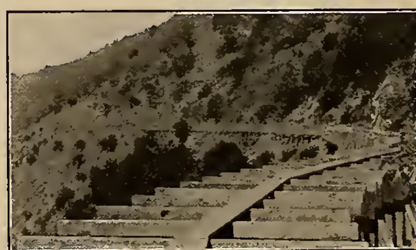
"About the year 1903 the management of the Bay Counties Power Company realized that the capacity of its system, which then consisted of the Nevada County Power Company's plant on the South Yuba, near Nevada City, the Yuba Power Company's plant on the Brown's Valley Ditch, and the Colgate plant on the North Yuba river, was not sufficient to take care of the prospective business of the company in the territory it was serving. I therefore took up the matter and started on a tour of investigation to find out the best place to establish a new power plant that could be run in connection with the Bay Counties

The De Sabla Power Plant, Showing the Boarding-House in the Background.



Showing Location of De Sabla and Centerville Power Plants, Water Ditches, and Nearest Towns in Butte County, California.

The Centerville Power-House.



Flume on Centerville Canal Below De Sabla.

A Bit of the De Sabla Pipe Line.

system. The Bay Counties Power Company had already acquired a water right on French creek, a stream emptying into the Feather river at a point a short distance below the present power house of the Great Western Power Company at Big Bend. The superintendent of the Bay Counties Power Company at that time was L. M. Hancock, and his first assistant was T. E. Thebreath. On that trip to French creek I took T. E. Thebreath with me.

"We then outlined a plan of development. It consisted of the building of a restraining dam in French Creek valley. The restraining dam was to form a lake, which, to the best of my recollection, would have held about 500,000,000 cubic feet of water. The water from this lake was to have been taken through a tunnel. The tunnel was to have been constructed through the range of mountains separating the proposed lake from the Feather river. The tunnel was to have been about a mile and a half long. A pipe-line about 6000 feet long was to have been constructed. This would have given a fall of about 1200 feet, and a capacity at the power house of about 10,000 kilowatts, or 13,400 horsepower.

"We then formed the Butte County Power Company, with a capital stock of $1,000,000 and an authorized bond issue of $1,000,000 for the purpose of constructing this plant. The stock was to be owned by the Bay Counties Power Company, and the bonds were to be placed with some one of the bond firms.

"A camp had been started at French Creek, a lot of preliminary work had been done, roads had been built, and so forth. Practically all of the land in the reservoir site had been acquired, with the exception of one parcel. This unacquired area belonged to certain persons whom I knew personally and whom I had every reason to think would be friendly.

"I had practically placed the bonds with a San Francisco bond house. I then made a visit to French Creek to go over the proposed construction. While I was on the trip to the site the sale of the bonds was confirmed. I met the people who owned the small area of unpurchased land. It amounted to one or two hundred acres in the reservoir site, out of a total, which the reservoir would have covered, of about four hundred acres.

"These people then told me that they wanted $200,000 for their holdings, or half the stock of the Butte Counties Power Company. It was about as artistic a holdup as I had ever encountered. My only answer was to call for T. E. Thebreath, who was in charge of the construction, and immediately order him to close down all work, discharge all the men, and consider the French Creek development as a dead issue. I then, in front of the persons in question, turned to the representatives of the bond firm and informed them that the deal was off as far as they were concerned, as the Butte County Power Company was a dead issue, due to the exhorbitant price that was being asked for the one or two hundred acres of land in the reservoir site.

"Having in mind to purchase the water systems of the Cherokee Mining Company and also to purchase the Centerville plant, which was owned by the Butte County Electric Light & Power Company, I then formed the Valley Counties Power Company, with a capital stock of $2,500,000 and an authorized bond issue of $2,500,000. The bonds were to be guaranteed by the Bay Counties Power Company, and all of the business of the Bay Counties company in Butte County was to be turned over to the Valley Counties company, in consideration of which the Bay Counties company was to own all the capital stock of the new Valley Counties company.

"I therefore made arrangements and purchased the property of the Butte County Light & Power Company. Its holdings consisted of the now-existing Centerville Ditch, which has since been enlarged, and a plant, having a capacity of about 1000 kilowatts, with a pole-line to Oroville, where it had a contract with three or four gold dredges, and a pole-line to Colusa, where it had a contract with the Colusa local lighting system.

"I then purchased from the Melons of Pittsburg the entire water system of the Cherokee Mining Company, the principal value of which was that part of the system comprising the head-dam, located in Butte creek, with a water right of about 4000 miner's inches. The ditch was in comparatively good shape, but the flumes were so old that they were practically worthless.

"While walking down the ditch for an examination of this system with T. E. Thebreath and R. L. Harter, the company's surveyor, we came to the conclusion that the best method of development was to divert the water at a point which was known as and may yet be called Slater's Dam; then to take the water by pipe-lines down a precipitous mountain-side to Butte creek. We estimated there would be a fall of about 1600 feet.

"From the top of the hill we could just about see the in-take of the Centerville Ditch on Butte creek. We therefore realized that the water of the Cherokee system could be used over again by the Centerville system, thereby increasing very much the value of the property of the company.

"So we sent our rig, which had met us at that point, down to Centerville. After planning Slater's Dam and reservoir we started to go down the hill, looking for a location for the proposed pipe-line, with a view to finding out what kind of a place there would be on the edge of the creek below for a power house. When we finally got down there, at the bottom of a mile slope, we realized that we had a pretty hard proposition. It was nothing but rocks. Almost the entire area would have to be blasted out. But we decided upon a point at once and started a camp.

"In order to build the plant the first thing that I directed to be undertaken was the construction of the present road that winds several miles from the top of the hill down to the power house. All other parts of the work, from rebuilding the flumes and enlarging the ditches down to increasing the Centerville plant, were started simultaneously.

"The first money was raised from a subscription by some of the principal stockholders of the Bay Counties Power Company. It was at a meeting held in my office in San Francisco, and $500,000 in bonds were taken by John R. Coleman, Theodore Low, R. R.

The Main Ditch That Supplies the De Sabla Plant With Water Power.

Eugene de Sabla Jr.

Bull Teams Hauling Machinery to Build the De Sabla Power House.

Camp One, Near the Reservoir, High Above the De Sabla Power-House.

Jack and Buck, the Black Mule Team at De Sabla.

Colgate, R. M. Hotaling, John Martin, William Pierson, and myself. After that the financing of the company was accomplished by the sale of the bonds to the general public.

"Inside of, I believe, one year the De Sabla plant was completed and furnishing current to its customers in Chico and in the Oroville gold-dredging district, and was delivering its surplus energy to the lines of the Bay Counties Power Company.

"Most of the construction was under the supervision of T. E. Thebreath. But toward the end of the work L. M. Hancock, the general superintendent, had charge.

"To the best of my recollection, the distance between the head-dam of the Cherokee system and the penstock, or Slater's Dam, is about twelve miles, and the capacity of the ditch about 4000 or 5000 miner's inches.

"Since that time, however, there has been developed another water system called the Henderson Ditch, which is about twenty miles in length. It brings some of the waters from the west fork of the Feather river through a viaduct formerly owned by the Cherokee company and called the Toadtown Ditch. It joins the main De Sabla system at a point about a mile and a half above Slater's dam, thus practically affording the company a double water system.

"During the progress of the construction work, while I was in Europe, some of my associates named the plant after me, because of the part I had taken in the inception of the enterprise."

At first the De Sabla plant was referred to as the

Nimshew power house. That was before it was officially named. Nimshew is a tiny hamlet up in the mountains a few miles from Camp One; it is the nearest postoffice to the power house. The Nimshew Indians, now extinct, used to occupy that part of California, and even down to the early mining days they controlled all the region southward to the American river.

Work did go with a rush on that De Sabla plant. There was blasting for the power house foundations, tunneling down the slope for the pressure pipes, damming for the storage reservoir, and first of all the construction of that long winding mountain road down into the bottom of the canyon. The great pipes are anchored in cement blocks at thirty-three places, and one of these anchorages is a mass of masonry weighing one hundred tons. All these precautions had to be taken to insure rigidity, because the force of the down-rushing water in those tubes is about seven hundred and fifty tons.

Where the Water Is Diverted From Butte Creek Just Below the De Sabla Power-House Into the Ditch Leading Down to the Centerville Plant.

Looking Down Butte Creek. The Ditch to the Centerville Power-House Skirts the Left Bank.

Twenty and thirty miles back in the mountains, through the primeval forest and its solitudes, come the great water ditches. They unite and pour their flood into the forebay reservoir on top of the ridge, a pretty, forest-skirted, artificial lake covering an area equivalent to about five city blocks. From that little lake extend the mighty pressure pipes that take the water down the mountain side to drive the De Sabla wheels; and later to batter against the wheels down at the Centerville plant.

The interior of the De Sabla power house is a model of simplicity, and its transformers and high-tension gallery have been considered the most perfect piece of engineering construction in California.

Coming down the mountain side through Indian Spring ravine, close to the boarding house, is a rivulet that cascades and gushes and flashes its spray in the sunlight. That small creek is fed by several tributary rills. It supplies abundant water for cooling the transformers and the electrical generators and for fire purposes and the domestic needs of the little community that lives there hidden from the world in a wonderful beauty spot where day and night the dull roar of waters and machinery disturb the silent majesty of Nature in one of her sublimest aspects.

There is that beautiful stream, gushing among mighty boulders. A picturesque suspension bridge extends from the clubhouse across the canyon to the wooded slopes and to winding pathways under sweet-scented foliage. In the water are trout. On those difficult slopes are just such haunts as deer most favor.

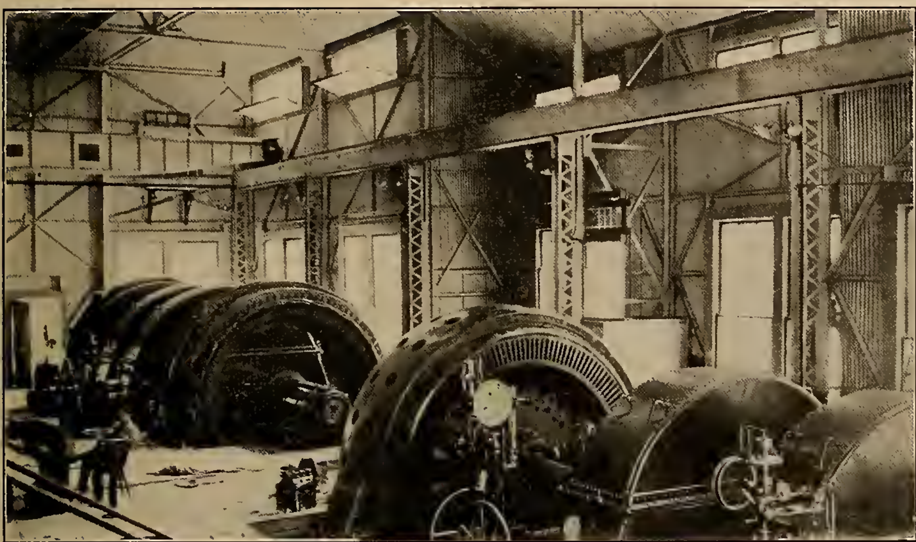
Some seventy feet up the hill above the power house are two large oil tanks, one containing oil for the transformers and the other the lubricating oil for the machinery and bearings. The fall creates a pressure and other devices increase it, so that oil is forced in everywhere to be sure that it penetrates well where speed is great and friction must not develop.

August 22, 1904, the fourth and largest generator was installed at the De Sabla power house to produce 5000 kilowatts. A new pipe-line was specially constructed parallel with the original one to drive the water-wheel that turns this powerful machine.

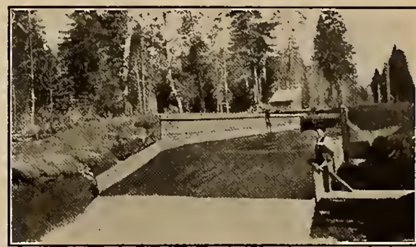
Early in 1906, after the amalgamated and augmented Bay Counties Power Company had become known as the Caifornia Gas and Electric Corporation, all its enterprises passed officially to the control and ownership of the Pacific Gas and Electric Company. In this transfer were involved the De Sabla and Center-

ville power plants, which are now part of the company's great hydroelectric system of eleven mountain generating stations and about one hundred electric distributing stations.

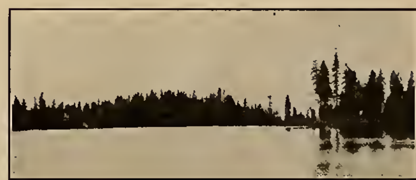
Comparatively few people will ever see the De Sabla power plant. It is difficult of access, isolated, apart. But its location is the most majestically beautiful place of all the spots where electricity is generated in California. As we rode up out of that canyon, the three silvery aluminum wires, thicker than a man's thumb, strung high overhead and pointing away to the southwestward, the thought came: if only more people down in the cities, those who use electric lights and enjoy the varied benefits of electric energy, could see this place and know something of the far-reaching waterways through the Sierra forest and the reservoir-lake and the pressure-pipe-lines, and that constant droning at the silvery building where water is doing the work of 17,000 horses, what an education it would be in the commercial development of natural resources, what a refining inspiration to gaze upon the varied beauties of that mountain scenery.



Generators in the De Sabla Power-House.



Hendricks Ditch Emptying Into De Sabla Forebay Reservoir.



Eighteen - Acre Forebay Reservoir Above DeSabla.

PHYSICAL DATA.	DE SABLA PLANT	CENTERVILLE PLANT.
Capacity of main storage reservoir	38,000,000 cu. ft.	same
Area of main storage reservoir	90 acres	same
Miles of main ditch and flume system	54.38	8.4
Miles of subordinate ditches and flumes	20	38.8
Flow the second in main ditch system	180 cu. ft.	190 cu. ft.
Pressure head (height of fall)	1,531 ft.	577 ft.
Force of water the square inch	664 lbs.	250 lbs.
Number of impulse wheels	4	1
Number of turbines	0	1
Capacity of generators in kilowatts	2,000; 2,000; 4,000; 5,000	900; 5,500
Total electrical horse power	17,420	8,576
Generating voltage	2,400	2,300 and 2,400
Voltage on power lines	60,000	60,000
Altitude of reservoir	2,600 ft.	same
Altitude at power house	1,000 ft.	575 ft.
Size of power house	50 x 109 ft.	32 x 110 ft.
Material of building	Concrete foundation, steel frame, galvanized iron covering	Concrete walls, galvanized iron roof on steel frame
Plant placed in service	October 22, 1903	May, 1900

AIR NITRATE FERTILIZERS.

Frank and Caro, two German chemists, have invented a process through which, by combining nitrogen gas with calcium carbid at a temperature of 1,000° C., they could produce a combination of lime, carbon and nitrogen—in other words, a synthetic nitrate of lime—to which they gave the name of cyanamid of calcium, now commonly known as cyanamid, which contains from 15 to 20 per cent of nitrogen, 60 per cent of lime, and has qualities as a fertilizer similar to sodium nitrate, or Chilean saltpeter.

The calcium carbid therefore was ready, the process for converting it into cyanamid by combination with nitrogen was perfected, and it only remained to provide an adequate supply of atmospheric nitrogen at a moderate cost. This requirement was met by a process invented by Dr. Carl von Linde, of Munich, which was patented in both France and the United States. By this process atmospheric air, having been first liquefied by compression, is subjected, by subsequent expansion under pressure, to a process of fractional distillation, by which the nitrogen is separated, leaving as a by-product oxygen of 50 to 60 per cent purity, which can be used by burning in the electric arc for the manufacture of nitrates and nitric acid.

The cycle was now complete, and it is through the combination of these two processes—the Linde method for recovering atmospheric nitrogen and the Frank-Caro method of combining nitrogen with calcium carbid for the production of cyanamid of calcium—that European progress hopes to provide for the future an adequate supply of nitrate fertilizer for agricultural purposes.

CONSERVATION OF WATER POWERS.[1]

BY L. B. STILLWELL.

True conservation of our natural resources means wise utilization of those resources without unnecessary waste. Such utilization is the primary and essential business of the engineer. During the last twenty-five years, a period practically co-terminous with the life of this Institute to date, the art of transmitting power by electricity has grown from a laboratory experiment into a development universally recognized as one of the great factors of industrial and commercial life. A very large proportion of the water powers hitherto unappropriated are either located upon government lands or are dependent, wholly or in part, upon the run-off from government lands. The regulations established by national and state governments which control or affect the further utilization of water powers, therefore, are of peculiar concern to the members of this Institute. A bill endorsed by the administration is now before Congress which, if passed, will confer definitely upon the President and his executive assistants full authority in respect of withdrawal of public lands and unappropriated water powers.

The Relation of Forests and Stream Flow.—The Bureau of Forestry has established regulations governing the appropriation of water powers located on streams which drain watersheds included in whole or in part in forest reserves. Among these regulations is the imposition of a graduated rental, to be paid by the individual or corporation appropriating the water power and used by the government for forest purposes. This rental rests upon the assumption that the appropriator of the power will be benefited by the preservation of the forest, and this idea is accepted generally by engineers and by the public. During the last two years, the question of the actual or assumed effect of forests on the watershed in regulating the run-off, has been widely debated. That forest cover controls the run-off to a material extent has been vigorously asserted by engineers prominent in the government service and by many others, and on the other hand, it has been seriously questioned by a number of our leading engineers. As regards that forest control which is practically related to the commercial value of water powers, the author believes the following to be a correct statement: While the aggregate annual run-off of our rivers in general depends upon the total annual precipitation, the presence of forest cover on the watershed regulates the rate of run-off to an extent which in many cases materially affects the value of the water-power, this regulation tending to equalize the flow and prolong it during the dry season.

The present form of permit provides a nominal charge (rental) for the land occupied by power house, dam, canals, penstocks, flumes, etc., the rate being "One dollar per acre and five dollars per mile for the land occupied by said works." It provides also that "the gross operation charge for any year shall be calculated by the forester upon the basis of the quantity of electric energy generated, in such year at a maximum rate, * * * * " which amount progressively increases up to the fiftieth year. The maximum rates are applicable only in cases where all the water utilized comes from the forest reserve and the entire head developed results from the topography of the forest. In all other cases, deductions are made.

The Imposed Rates as a Tax on the Power Enterprises.—The proposed conservation charge, at least during the early years of the contract, cannot be regarded reasonably as constituting any very serious financial burden imposed upon the individual or corporation developing the water-power. If power be sold at an average price of one cent per kilowatt-hour, the maximum conservation charge during the first five years of operation is equivalent to a tax of 0.61 per cent of gross receipts. During the next five-year period, it is increased to 1.25 per cent and it increases gradually from this figure to a maximum of 3.25 per cent of gross receipts, which rate applies during the last five years of the fifty-year life of the contract. The average charge during the fifty-year period is 2.086 per cent of gross receipts. It is a fair question, however, whether a more rational method, and one which in certain important respects would tend to produce better results, might not be devised. The plan in force obviously is open to several objections. Among these are: (1) The imposition of a tax upon output means that the man who installs a highly efficient plant is called upon to pay a higher conservation charge than the man who wastes water by the installation of a cheap and inefficient plant. (2) The proposed method of charging imposes a heavier burden upon the man who sells his power at a low price than upon him who sells it at a high price. (3) Under the plan proposed by the Forest Service the man who takes his power to a market, say 100 to 300 miles away, must pay to the government for the losses incurred in doing so and pays more than the man who sells to the home market. While the method of applying the conservation charge has been criticised in many quarters and while the objections above pointed out are valid, the method in force possesses undoubted advantage in the fact that it is definite and readily determined by reference to records which the permittee can readily keep. The charges, moreover, are adjusted to encourage development of the water powers by recognizing the fact that few, if any, can earn interest on the necessary investment from the start. Except by reducing the average charge for the period, it would be difficult to devise a plan less onerous for the permittee. (4) While the imposed charge could not be regarded as excessive, if the power developed were entirely, or even very largely, dependent upon the preservation of forest cover upon the watershed, it represents a high rate when measured in a comparison with the increase in commercial value of the power, which, under ordinary conditions, is due to the forest. (5) The tax is imposed upon power from all forest reserve lands, regardless of the actual condition of the forest upon which it is based. Obviously, therefore, a uniform tax must be very much heavier in some cases than in others, as compared with the benefit upon which it theoretically rests. (6) It tends to retard utilization of water powers and stimulates the use of coal for power purposes—a result which is in direct contravention of the primary object of conservation. (7)

[1]Abstract of presidential address at annual convention A. I. E. E., June 28, 1910.

Something less than one-half the public domain is included within the limits of the forest reserves. To secure maximum revenue and to minimize the average retarding effect upon utilization of these water powers resulting from a system of rental, any charges which may be imposed by the Federal Government upon water-power appropriation should apply to all public lands.

The effect of forest cover in adding to the commercial value of a water power, results from two facts, first, that an increase in minimum run-off reduces the necessary investment in auxiliary steam or other power plant; second, that some portion of the flood waters, which otherwise would flow past the power plant, at a time when the water available exceeds the amount needed, is held back long enough to permit its commercial utilization.

Features of the Present Regulation Which Should Be Changed.—Clause 15 of the power agreement now in force reads as follows: "The permit here applied for shall be non-transferable, and shall be subject to all prior valid claims which are not by law subject thereto." The aim in view, of course, is to avoid monopoly, as a result of which an artificial price might be maintained higher than the average which would be fixed by competition of similar developments in the same market. If effective, it is obvious that this requirement must retard development. The economic reasons which demand that water powers on the same stream should deliver their output to the same network of distributing circuits in many cases are material, and those which demand that the output of developments on different streams should be similarly combined are even more weighty. By electrically combining the output of a considerable number of water powers, interruptions of service, due to accidents to flumes or to transmission circuits, are decreased. The clause should be modified by permitting transfer, subject to approval by the government.

Continuous Operation of Plant.—Clause 18 reads as follows: "The permittee shall, except when prevented by the act of God or the public enemy, or by unavoidable accidents or contingencies, continuously operate for the generation of electric energy, the works to be construed under the permit hereby applied for, in such manner as to generate after such generation begins," not less than certain percentages of the full hydraulic capacity of the works measured in kilowatt-hours. The object in view is to prevent a power company increasing its prices by creating an artificial power famine and to secure full utilization of the available power. Some permits have specified that not less than twenty-five per cent of the full hydraulic capacity must be generated; others as much as seventy-five per cent, depending upon special circumstances supposed to govern the case. In many cases this clause presents serious difficulty to the power company. If it be necessary to retain such a clause, it should be accompanied by a provision permitting, with the consent of the government, a reduction in the percentages originally fixed.

Term of Permit.—Clause 20 of the permit in force reads as follows: "The permit hereby applied for shall cease and be void, upon the expiration of fifty years from the date of approval hereof, but it may then be renewed in the discretion of the duly authorized officer or agent of the United States, and upon such conditions as he may in his discretion fix. * * * *" This clause contains no provision for taking care of the contracts which may be in force between the permittee (or his successor) and his customers at the expiration of the fifty-year period. It is obvious that by its absence the value of the permit during the latter years of its life, is materially impaired. Power contracts are frequently, in fact generally, executed for periods of not less than five years and frequently for ten or ever twenty years. The contract agreement should include a clause guaranteeing for a period not less than five years subsequent to its termination, the fulfillment of contracts between the permittee and customers existing at that time.

The Permit Revocable.—Under the law as it now stands the Forest Service can grant to an individual or corporation seeking to develop water-power from forest reserves only a permit revocable by the Secretary of Agriculture in his discretion. No argument is necessary to demonstrate that a permit revocable in the discretion of the head of a department is not an adequate basis for financing an enterprise requiring investment of capital.

An Alternative Plan.—Assuming that upon careful consideration the American people should decide to impose a tax upon natural resources of the public domain, to be used in conserving and developing those resources, it is perhaps not improper to suggest the outlines of a plan which from the standpoint of public policy appears preferable to that now in force. The essential features of the plan which Mr. Stillwell suggests are the following:

(1) A tax imposed on all sources of power found upon public lands—a royalty on coal mined and a rental upon water-power. The charge for water-power to be based not upon an indefinite and disputed relation of forest covering and commercial value of the power, but upon the fact that the government needs revenue to develop and conserve our natural resources, owns the power, and, as owner, possesses an unquestionable right to impose a charge for its use. The Federal Government is now selling coal lands on the public domain at prices which, on the average, approximate one-tenth of one per cent per ton of the coal which it is estimated the property can commercially yield. If the coal be used to produce power under average conditions this tax is substantially equivalent to 0.5 cents per 1000 kilowatt-hours as against an average rental of 20.86 cents per 1000 kilowatt-hours now imposed in the case of water-power. The theory of conservation unquestionably points to an increase in the price fixed for coal lands or a decrease in waterpower rental, or both. The general features of the present contract agreement enforced by the Forest Service as regards fifty-year limit of the period of appropriation should be preserved. The other restrictions now imposed should also be retained except that certain clauses should be modified to meet the practical objections which have been pointed out.

(2) The charge imposed upon water powers should be based upon the amount of water appropri-

ated and the effective head resulting from the topography of the government lands concerned. Under the present plan, it is necessary to measure the water in order to fix the third deduction from the charge based upon output. The difficulty of measuring water, therefore, must be met and it is easy to fix the second-feet appropriated as to fix the deduction allowed for artificial storage by a permittee.

(3) The third suggestion is that the government engineers of the department of bureaus concerned develop comprehensive preliminary plans for the development of water powers of a given watershed and that these water powers collectively or severally be leased to the highest bidder, the government, of course, reserving the right to reject all bids.

THE WATTHOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

(Concluded)

APPENDIX.

Fig. 2 is the vector diagram of a potential transformer. OE is the primary e.m.f. OE' is the secondary e.m.f. OI is the primary current, OI' the secondary

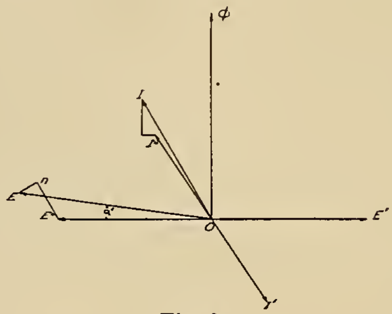


Fig. 2.

current and II' the exciting current. E''N is the e.m.f. consumed by resistance or is the RI drop, EN the e.m.f. consumed by the reactance or is the XI drop, and EE' is the impedance e.m.f. of the transformer. In the figure it will be seen that the secondary e.m.f. (OE'' referred to the primary) leads the primary e.m.f by an angle a'. This will tend to make the meter run slow on inductive loads.

Obviously, if a of the current transformer equals a' of the potential transformer there will be no error from this source, and it is attempted in the design of meter transformers to approximate this condition. For this reason considerable resistance is introduced into the potential transformer to increase this angle. This high resistance results in a transformer of poor regulation, but the regulation is not important, as the load is constant and the range recommended narrow.

In practice, the angle a of the current transformer is greater than the angle a' of the potential transformer. This difference can be compensated in the lag of the meter. Suppose, for example, the meter is not lagged properly by the angle ω. Then, if $a - a' - \omega = 0$ there will be no error from this source. In other words, the meter is lagged so that it will run slow on inductive loads. The combined effect of angular displacement in the potential transformer and of the meter not being lagged quite ninety degrees just compensates for the angular displacement of the current transformer.

These angles may be determined and corrections made as follows: The results obtained by this method are sufficiently accurate for adjusting service meters since finer corrections could not be made on the meters themselves.

With an indicating wattmeter the power flowing in a circuit of 50 per cent power factor (or other known power factor) is read. A one to one ratio current transformer of the type used with the watthour meters is then inserted in the circuit and the current for the watt-meter is taken from the secondary of the current transformer. The power is again read. Assuming that a power factor of 50 per cent is used, from the first reading we get $W = EI \cos 60°$ and from the second reading $W' = EI \cos (60 - a)$. The angle a is the angular displacement due to the current transformer. From the above

$$\text{Cos}\ (60 - a) = \frac{W' \cos 60°}{W}.$$

From which we can readily obtain a. Before substituting in the formula W' should be corrected for error in transformer ratio. The current coils of the watt-meter are again connected directly in circuit and the potential supplied by potential transformers, two transformers being used, one to step up from the line voltage and the other to step down again to the watt-meter. We can now obtain the angular displacement due to the potential transformers by applying the same formula as given above for current transformers. The angle thus obtained for the potential transformers will be twice the angle of one transformer, and as it is the angle of one transformer with which we are concerned the result obtained should be divided by two. This will give us the angle a'. We will then lag the meter, not for 90°, but for $90° - (a - a')$.

Another and quicker way of applying this method is to determine the error introduced by two potential transformers at unity and at 50 per cent power factor. Each transformer is responsible for ½ of the error. Now connect the watthour meter in circuit with the current transformer and with two potential transformers, one potential transformer, stepping up from the line voltage (testing circuit) and the other stepping down to the watthour meter. The indicating watt-meter should be connected directly in the circuit without current or potential transformers. The watthour-meter is than adjusted at unity power factor and at 50 per cent power factor to disagree with the indicating watt-meter by the amount of the error due to one potential transformer. There will be errors due to three transformers, one current and two potential. The watthour-meter is to operate with but two transformers and should be adjusted to compensate for the errors of only two transformers. By not compensating for the error of one of the potential transformers, as outlined above, the desired results will be accomplished.

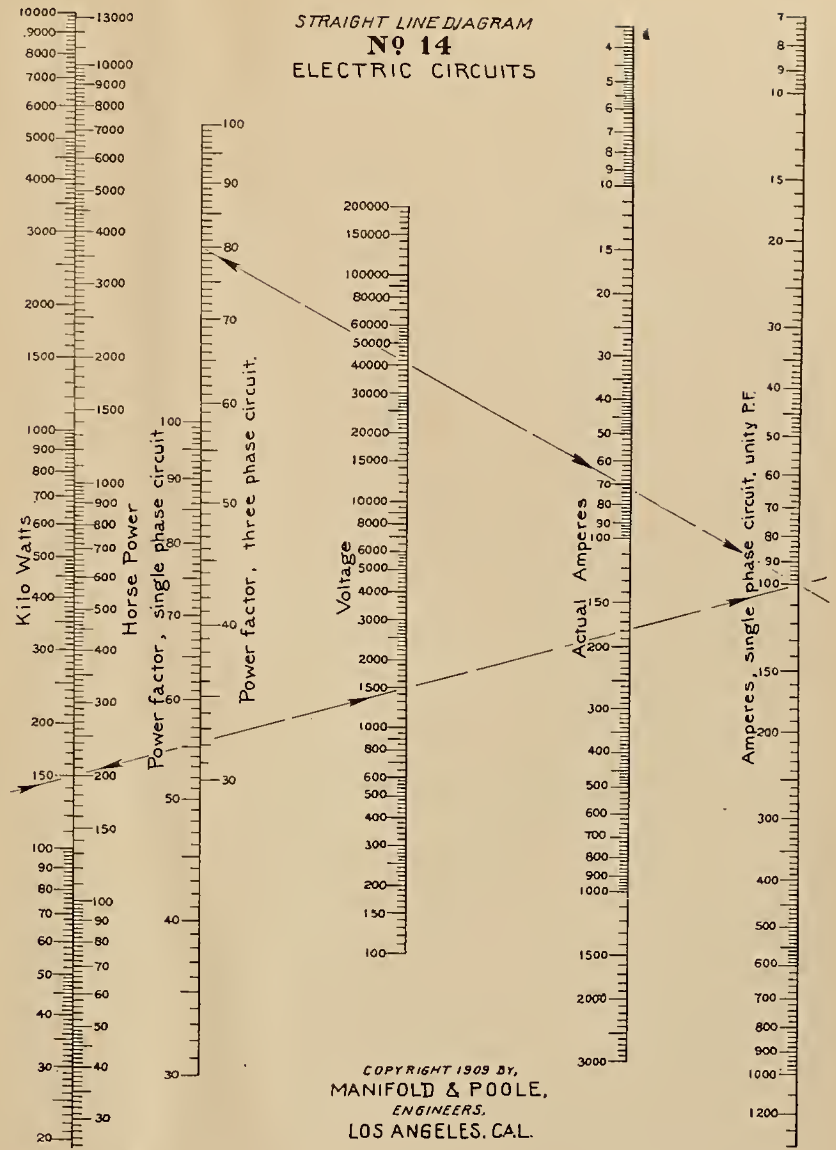
It is not strictly correct to take ½ the error of the two potential transformers, as outlined above, as the error of one transformer; it is, however, very close, closer than adjustments can be made on the watthour-meter.

MECHANICAL CALCULATION OF ALTERNATING WIRING PROBLEMS.

The formidable mathematics that is involved in calculating alternating current electric circuits deters many an engineer from attempting to solve even the simplest problems. It is possible however to perform these calculations mechanically by means of diagrams, among the simplest of which are two printed herewith by permission from Manifold & Poole's "Straight Line Diagrams."

A frequent problem in wiring work is the determination of the volt drop or loss that occurs in transmitting a given number of amperes over a given size wire at a given voltage for a definite distance, or, given any four of these to determine the fifth, such as the size of wire that will cause a given line drop.

With direct current the problem is solved from Ohm's law, E=RI, where E, the fall of potential, is equal to the product of R, the resistance in ohms, and I, the current in amperes. The same relation is true with alternating currents if for the ohmic resistance of a circuit we substitute its impedence, a value which includes the ohmic resistance and the reactance. This latter factor depends upon the frequency, or number of times per second the current reverses in direction, the distance between the wires and the coefficient of self-induction or so-called "electrical inertia," by which the circuit opposes any change in direction of the current.



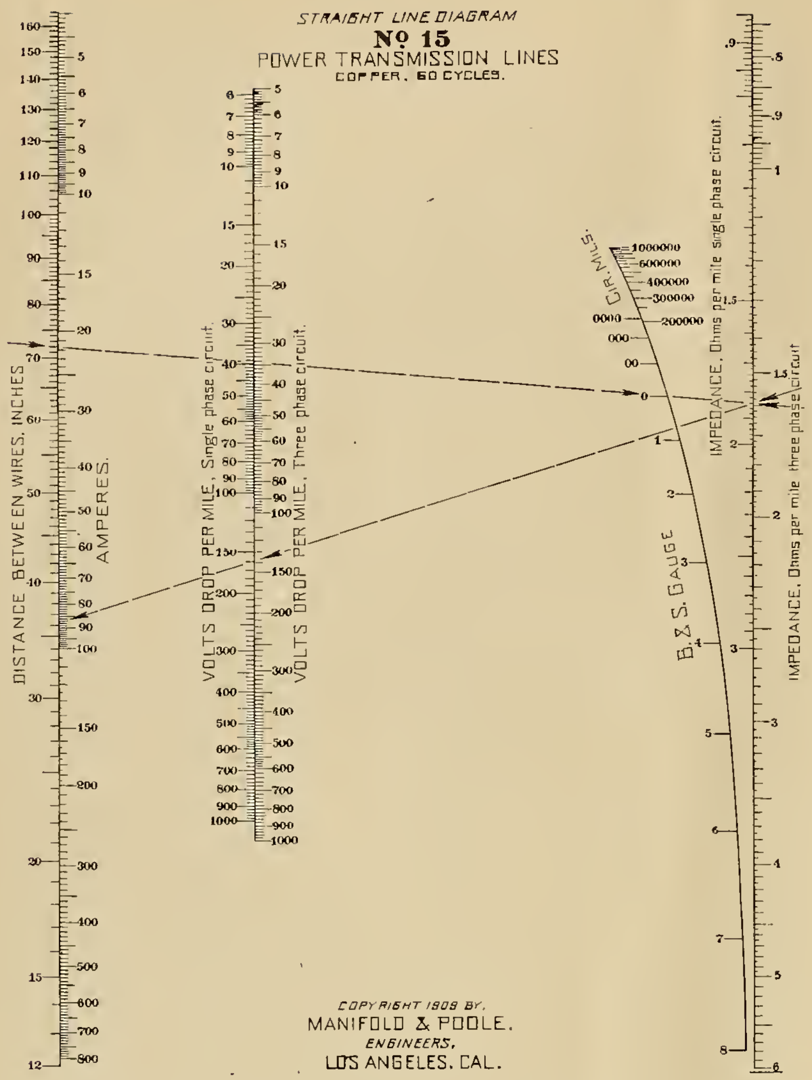
Power in a direct current circuit is equal to the product of volts and amperes (W = E I). In a single phase alternating circuit, due to the induction, the current is not in phase with the pressure or voltage and consequently to show the true power, the product of these values must be multiplied by the power factor or cosine or the angle between them (W = E I x power factor). Where there is no induction the power factor is unity or 100 per cent, decreasing as the induction increases. For three-phase circuits it is necessary to multiply by the $\sqrt{3}$ to obtain the total power (W = $\sqrt{3}$ E I x power factor).

With these facts in mind, to find the volt drop in transmitting power in alternating current circuits, it is first necessary to determine the actual number of amperes from diagram No. 14 and then determine the drop from No. 15.

As will be noted there are seven scales plotted on No. 14; the first scale is laid off from 20 to 10,000 kilowatts, the second gives the equivalent values in horsepower, the fifth is laid off from 100 to 200,000 volts. These scales are so placed that a straight line passing through any value in the first two and any voltage in the fifth will intersect the seventh scale so as to show the number of amperes in a non-inductive circuit. By connecting the values thus determined with the power factor for either single phase or three-phase circuits as marked on scales three and four, the actual amperes transmitted may be read on scale six.

The example indicated by the arrows on No. 14 shows that with 150 kilowatts at 1500 volts, 100 amperes are transmitted at unity power factor, or 70 amperes at 80 per cent power factor three-phase, or reversing the problem, with an 80 per cent power factor three-phase circuit, we find, that, to transmit 70 amperes it will require 150 kilowatts at 1500 volts.

Diagram No. 15 has been made for copper transmission lines at 60 cycles. Scale 1 is laid off proportionally to the distance between the wires from 12 to 160 inches; scale 5 is laid off according to the wire size in the B. & S. gauge from 8 to 0000 wire and from 200,000 to 1,000,000 circular mils. By passing a straight line through the value on scale 1 showing the wire spacing, and the size of wire on scale 5, the impedance in ohms per mile for single phase and three-phase circuits may be read on scales 6 and 7 as shown by arrows. No. 0 wire with 72-in. spacing has an impedance of 1.6 for three-phase circuits and 1.84 for single phase circuits. By passing a straight line through the number of amperes shown on scale 2, as determined from diagram No. 14, and the impedance



on scale 6 or 7, the volt drop per mile for either single-phase or three-phase circuits may be read on scales 3 or 4.

Another problem that frequently arises is to determine the size of wire and the spacing that produces an allowed line drop when a given number of amperes are to be transmitted. This may be accomplished by reversing the process. As shown by the arrows 88 amperes when transmitted with a drop of .160 volts per mile single-phase, or 140 volts three-phase with 72 in. spacing requires No. 0 wire. These calculations assume that capacity effects are neglible.

TARSUS LIGHTED BY ELECTRICITY.

The ancient city of Tarsus, in Asia Minor, has recently been lighted by electricity. In reporting this fact, Consul Edward I. Nathan, of Mersine, says the power is taken from the rapidly flowing Cydnus river. About 1½ miles from the city an 80-horsepower turbine is made to drive a large dynamo, which furnishes sufficient power for 1000 lamps of 16 candlepower each; 450 are now used to light the streets of the city and the remainder will be furnished to private consumers. It is proposed to extend the electric-lighting system to Adana and Mersine, the power to be likewise furnished by the Cydnus river and transmitted by wire to these places.

COMMISSION CONTROL OF PUBLIC SERVICE CORPORATIONS.[1]

BY F. P. ROYCE.

I am to speak today upon matters connected with public service corporations, particularly those doing what may be termed a local business, one which is conducted in a single city or perhaps in a group of adjoining municipalities, as distinguished from those public service corporations whose field of operations is much more extended, usually over more than one state, such as the transportation, telephone and telegraph companies.

Of these "local" companies the most important are those manufacturing and distributing gas, electricity and water for all purposes, street railways and certain telephone companies. The interests of nearly all of the local telephone companies, however, are now so closely identified with the interests of the large corporations doing an interstate business that they are really a part of such properties.

The relations between the public utility companies mentioned and the communities they serve are of such a close character that the results of operation are of direct importance to both. In the first place, in order that these companies may do business at all it is necessary that they should have franchises granting them the right to use the public streets. While it is proper that this should be done, as it makes it possible for the necessary plants to be constructed with the least possible outlay and consequently reduces the capital charge on which a fair return may be earned to a minimum, helping to make the rates for service as low as possible, it is true that the public having granted the franchises to the companies have an interest in the properties and are entitled to certain consideration which they would not otherwise have.

On account of the conditions surrounding these companies they must of necessity be in a sense monopolies; that is to say, they must be free from competition with companies doing the same business in the districts they serve, provided they furnish service of proper standard at substantially as low a price as any other company operating on legitimate lines could do. To undestand this statement it must be seen that the character of the business done is entirely different from almost any other. These companies are all limited in the field of their operations to the exact location of their properties. A gas or electric company can only do business along the line of its permanent distributing system, and a street railway company has no earning power except on its roadbed. Any other manufacturing company producing some portable commodity may develop an unlimited field. If, for any reason, on

[1]Extracts from an address before the Graduate School of Harvard University on May 16, 1910.

account of local conditions, one such company has any advantage over another in one section and the latter company cannot in consequence market its products there, it is free to go elsewhere to develop other fields, but the public utility company cannot do this. When any part of its distribution system is once completed it cannot be moved except at too great a sacrifice. If competition is permitted under these conditions, either one of two things must happen—the company will be unable to earn a fair return on its property or will be obliged to lower the standard of its service to a point where it will no longer be satisfactory to the public served. It is therefore essential to all interested that every community should be served by successful public service companies. Duplications of electrical distribution systems either above or below the streets or of gas distribution systems under the streets are distinctly uneconomical, and in nearly all cases where such duplications have been permitted the ultimate result has been that the two properties eventually became united, with a large waste in the plant really necessary to do the business and consequently a heavy increase in the capital charge.

While gas and electric companies are in competition along certain lines, it is very likely true that this competition may be of a healthy character; and it is also true that each kind of company has a field for business of its own, so that both may succeed while serving the same community.

Certain interesting cases bearing on the propriety of the right of an electric light or power company doing business in any community to be free from competition, have risen in places where such companies generating their current by steam power have operated for a time and later on good water powers have been developed within such distance that the current generated at the water power can be satisfactorily transmitted to the locality already served. If these water powers have been developed at a reasonable cost and actually have a sufficient and fairly uniform capacity of production, it would probably be true that they could furnish current to the community already served by the established company using steam as a motive power at a less cost than could the latter company. In cases of this sort it must be borne in mind that the existing company is only entitled to freedom from competition so long as the community is furnished with energy at substantially as low a price as it could be provided by any other company operating on legitimate lines, being in this instance at the price it could be furnished for by the water power company. The proper solution of such a situation is for the water-power company to sell its product to the existing company, which, in turn, will distribute it to its customers. By doing this a duplicate distribution system would be avoided and the original steam plant of the existing company could be used for relay purposes. By following such a course the existing company could maintain its fair profit and the consumer would have the benefit of a reduction in cost due to the fact that the energy purchased was generated by means of water-power.

In view of the fact that to conduct their business the companies must have franchises granted by the public and also that they should have an opportunity to do business free from injurious competition, the public served have the right to demand that the service furnished by the company should be of a high character, that the company should be willing to make extensions of their lines wherever they are reasonably required and that the prices charged should be fair for the service rendered. The obligations, however, are by no means entirely on one side, and the company which meets these requirements of the public having invested money in good faith in the undertaking has the right to earn a fair return on the value of the property needed to conduct its business and to be free from competition from other companies doing business of the same character in the territory served.

Such companies should so far as possible be free from attack by persons who even though well meaning are ignorant and misinformed in regard to actual existing facts. This is important to the public as well as to the company. For example: if a company doing its business well and fairly is the subject of many unfair statements, it is probable that these statements will have their effect on the holders of the company's securities. It then becomes more difficult for the company to continue its necessary financing and it is obliged to pay more for the money it needs, which must be reflected in higher prices to the public served.

In the early days of these industries their business was of a distinctly hazardous character. There have been times when the future of each was by no means assured, when the earning capacity was a matter of doubt, and in those days it was essential that they should receive the most liberal treatment from the communities served or it would have been impossible to make satisfactory progress and to raise the capital necessary for their development. Today these public utilities are in many cases on a sound basis. Mistakes have been made in many instances; some properties have not been designed with good judgment and are not adapted to the service required of them. Such companies still have a time of uncertainty before them when unusual courage and energy are needed on the part of the operators. In a majority of cases, particularly in the larger communities, the companies have been developed properly; their future is assured so far as can be seen, and it is probably true that the public should now receive more from such successful companies than it formerly did and that such companies themselves are satisfied with somewhat less in the way of future profits than they formerly were. The statements above made as to the rights of both interests are gradually being accepted as sound by them, and there is a growing belief that proper methods should be provided to insure their maintenance.

The best plan that has as yet been devised for this purpose is to provide for the organization of state commissions which have the right to supervise the affairs of public utility companies and the power to adjust certain differences that may arise. It is essential that the duties and powers of these commissions should be limited to supervision and that they should have the right on behalf of the public to see that the rates charged by the companies are fair, that extensions are made wherever they are reasonably required and that the service is as good as should be furnished

under existing conditions. They should also have the right to regulate the issue of securities by the companies and to see that these represent the fair value of the properties. On behalf of the companies, they should have the right to protect them against improper competition so long as they continue to do their duty toward the public served. This plan of supervision by commission has met with growing favor. Massachusetts was the first state to take this step. Twenty-five years ago the legislature passed the necessary laws to provide for the Board of Gas and Electric Light Commissioners and to specify its duties, which have been added to from time to time. The commission now has the right to authorize or refuse the issue of bonds and of stock to be issued by the gas and electric companies. Bonds cannot be issued at less than par, and in the case of stock issues the commisssion has the right to determine the price, not less than par, at which they may be offered proportionately to stockholders. They also have the power from time to time to determine rates for gas and electricity and can order extensions of lines when reasonably required to furnish service to new customers. Similar powers of supervision and adjustment of rates are exercised by the Board of Railroad Commissioners over the street railway companies and by the Highway Commission over the telephone companies. This plan of supervision by commission has now been followed in New York, Wisconsin, New Jersey and other states. With them it has been usual not to follow the Massachusetts plan of having service commissioners but to have one public service commission having the powers mentioned over all public utility companies.

The powers and duties of these commissions are of vital importance and call for distinctly judicial ability in the members. The determination of fair rates for service is one of the most difficult and important. It has now been firmly established by the decisions of the United States Supreme Court that any company is entitled to a fair return on the value of the property owned and necessary to conduct its business, but no general rule applicable to all companies has been determined to establish what a fair return is, and it has been made clear that it will continually vary under different conditions. The history of these public utilities shows that in the early stages of their development their business was hazardous, and at such time those investing their money in various enterprises of this sort were entitled, on account of the risk they ran, not only to a fair income on the money invested but also in case the enterprises succeeded to a gain in their capital. As these public utilities were developed and the permanency of their business became more assured, capital was more readily attracted and could be procured on more reasonable terms. In many cases the companies were successful in making for their stockholders a fair rate of income and also were able to accumulate a surplus. This surplus has sometimes been the subject of criticism, for as it is now possible to get capital for successful companies on a reasonable basis the public forget that within a few years the condition was so different that at that time the money necessary to develop a business could not be procured without the prospect of a large profit, and that if it had not been so procured development would have been greatly retarded and the low cost of production today would have been impossible.

Perhaps the most important rate case recently decided was in 1909, when the United States Supreme Court ruled that an order passed by the New York Legislature, fixing the rate for gas in New York City at eighty cents per one thousand cubic feet, was fair and reasonable. In this decision the Court recognized the fact that the company was entitled to a fair rate of return on its entire property including its "good will," or, as erroneously called, its franchise value, and stated that in the court's opinion such a return should not be less than six per cent per annum in that particular case. It is apparent that no company is more firmly established than the gas company in New York and none are subjected to less danger from possible future developments. Consequently this decision may be fairly taken to mean that public utility companies, when permanently and strongly established, are entitled to a return of six per cent on the value of the property actually required to conduct the business, and it naturally follows that those companies having less stability and less certainty of permanent success are entitled to a higher rate of return.

It is important that the commissions who are called upon to pass on rates should establish approximately what may be called a standard of efficient operation, which, if followed, will entitle the company in question to the rates of return referred to; but, on the other hand, those companies having managements which have shown unusual ability, resulting in decreased cost of operation and unusually low rates to consumers, should be rewarded by an even higher rate of return on their property; otherwise there is not sufficient incentive to the best management. This principle has been recognized in the so-called sliding scale system under which many of the gas companies in England now operate, and which is also followed by the Consolidated Gas Company of Boston.

Companies should be allowed to charge rates which not only permit of fair returns on the investment but which will also be sufficient to provide for necessary depreciation of plant. This is essential, so that there may be at no time any impairment of assets.

The rate of depreciation in connection with the different kinds of public utilities varies materially and it is essential that the commission should have a full knowledge of the facts.

Another of the most important powers of these commissions is to determine the amount of securities to be issued by any company under their supervision. This involves many considerations and in some cases is a more difficult matter even than the determination of fair rates.

The ability of a public service company to procure at reasonable rates the capital required to properly develop its business is probably the most important factor to be considered in connection with these companies today. It is vital to every undertaking that money must be procured or the development cannot go on. In nearly all cases a study covering a term of

years of the operations of these companies will show that the increase in the amount of capital necessary to extend their business as required has been at a greater rate than the increase of the annual gross earnings. That is to say, if a company has shown an annual increase in its business of say 10 per cent it is usually true that the increase in the capital charge has been considerably greater. This has been due to several causes.

1st. The standard of service required has been continually raised and more expensive plants are necessary to meet it than was formerly the case.

2d. The prices for gas and electricity have been continually reduced and a much larger output from any plant is neecssary to produce a given return than was formerly the case, from which it follows that the plant producing the output must have a greater capacity and a greater value for the same monetary return. Furthermore it will be seen that the yearly increase of the capital requirement must be figured on a compounded basis and is consequently of extremely rapid growth.

The ideal plan would be for the entire cost of any property to be represented by an equal amount of permanent securities taken at their par value, but in many cases such a plan would be impossible, as the necessary funds could not be procured on that basis. As has been said, those who invest in such companies when the business is undeveloped and the future precarious are entitled to a profit on the capital invested, and the only effective way to make such a profit possible is to sell securities at a fair and proper discount from their par value. These conditions are true today in connection with certain companies, notably those developing water power in remote sections, where the market for power must be largely developed, and certain lines of new street railways. In such case the plan of selling securities at a discount must still be followed or the money necessary cannot be procured and the important utility will remain undeveloped. Both in the determination of rates and the amount of new securitieis to be issued, it is usually necessary to ascertain the real valuation of the property of the company under consideration. In all such cases the following elements of valuation should be determined:

1st. Structural valuation covering the physical property.

2d. Amount of working capital necessary.

3d. Intangible property.

In considering the structural valuation it is necessary to show the cost of reproducing the property new at the time of its examination, and in doing so the commission must add the cost of employing competent engineers, the interest on capital necessary to pay for the construction but having no earning power during the building period, and the cost of necessary organization. They should also take into consideration the fact that any plant must be built gradually, additions being made from time to time as demand arises, and that the costs of this intermittent on piece-meal construction is much greater than it would be if the entire plant were built continuously at one time.

In considering the value of real estate, any appreciation in land values should be credited to the plant. From the total value so determined must be deducted a fair amount to cover any depreciation that may actually have taken place in any part of the property.

Working capital is as essential as machinery. No company can be operated without coal, oil and supplies, and a reasonable amount of cash must always be on hand to meet any contingency and a fair amount provided for operations.

The principal intangible asset consists in the value of what is ordinarily known as a "going business." This may perhaps be best defined as the difference between the value of the plant as an accumulation of land, building, machinery and supplies and the same property with a developed market and an actual earning capacity.

In order to build up such a business it is always necessary to spend large sums in instructing the public, through advertising, soliciting, etc., in the value of the service to them.

Losses are incurred in making initial installations or extensions of plant which for long periods of time may remain unremunerative. The cost of experimental work is always heavy and structural losses are frequently incurred due to the necessity of changing apparatus to meet new conditions, which changes were in no wise due to the fault of the management. All of these expenses are real, must be borne by the companies and represent actual and permanent value in the successful business development. It is frequently held by the public, but clearly in error, that all of this value of the "going business" is really represented by the franchise, and that as the franchise was granted to the company by the people without cost it is not proper to capitalize it. The fact is that the franchise was merely a permission to use the public highways and that while this mere right to use may in itself represent no part of the property on which the company is entitled to earn a fair return, it is nevertheless true that the business which the company has built up at a large expense after receiving permission to use the highways has a very real value and is an asset of the company on which it is entitled to a fair return.

Having determined the fair valuation of any property which may be represented by securities, the commissions have the power to approve the kind of securities which the management of the companies wish to issue. The companies should procure the necessary money on as low a basis as possible. To do this in connection with the development of any new project a bond issue is usually necessary. This must be for only such an amount that the annual fixed charge representing the interest and perhaps a sinking fund shall be considerably less than the assured net earnings. The balance of money required should be procured by the sale of common stock or, if the project is a large one, by a moderate issue of preferred.

In the states where commissions have been organized, the public utility companies are nearly all on so sound a basis that money for extensions may be secured with little or no discount on the securities and they have not yet been obliged to pass on cases where a large discount on the new common stock issue will be necessary in order to procure the capital needed.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

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LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Standardizing Engineers

Public safety demands that members of certain professions be licensed before they can practice. Thus, a physician must prove his proficiency in prescribing medicines, and a pharmacist his experience and ability in compounding them. This is a necessary measure for the protection of public health.

No such protection is now afforded against the menace of a badly designed or poorly built engineering structure, which affects the safety of not one, but many individuals, and whose failure furthermore involves heavy financial loss. A mistake in calculating a bridge truss or the foundation of an office building is more disastrous than an error in diagnosing a disease. Poor judgment in selecting a water source or disposing of a city's sewage causes far more sickness than can be laid at the door of the druggist. We allow the veriest tyro to wire our homes for electricity or pipe them for gas, when the slightest fault in their connection is fraught with danger to life and property. The lives of thousands of industrial workers are daily entrusted to the devices of the engineer without a thought as to their proper safeguarding. There is no general law that prevents any man with the smallest smattering of engineering knowledge from opening an office and doing such work as comes his way, provided he can convince others of his ability. This last saving proviso is fortunately effective in eliminating the unfit.

Realizing the necessity of protecting the public from incompetent and irresponsible practitioners and understanding that the present state of affairs is a detriment to the standing of their profession, the American Society of Civil Engineers recently appointed a committee to formulate proposals for laws, regulating the licensing of engineers. This committee finds that there is already a significant trend of legislation in this direction and urges the necessity for uniformity throughout the country, especially as to what constitutes a civil engineer, their definition being:

> "A civil engineer, within the meaning of this act, is one who practices any branch of the profession of engineering other than military. Said profession embraces the design and construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary systems, and the development, transmission and application of power, and includes all industrial, hydraulic, municipal, structural, electrical, mechanical, mining and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation."

The suggested requirements for practicing are the same as those for corporate membership in the Society and are to be determined either by membership therein or by State examinations. Similar requirements exist in Quebec, Canada, and licenses are already required for irrigation engineers in Wyoming, civil engineers in Louisiana and land surveyors in Idaho and South Dakota. It is to be hoped that other States will take like action in providing a needed factor of safety.

PERSONALS.

G. McM. Ross, an engineer at Stockton, Cal., is at San Francisco.

C. F. Conn of J. G. White & Co., has returned from a flying trip to New York.

H. C. Eastman, an electrician of Guerneville, was a recent San Francisco visitor.

E. P. Jamison, an iron and steel manufacturer of Seattle, is a San Francisco visitor.

W. D. Thomas, an electrical supply dealer of Petaluma, visited San Francisco last week.

M. F. Jenifer, a telephone official of Los Angeles, spent a few days at San Francisco last week.

Paul Shoup, assistant general manager of the Southern Pacific Company, in charge of electric lines, is at Chicago.

A. C. Sprout, electrical engineer, has been confined to his home in San Francisco for the past week by a slight illness.

F. C. Todt of the Western Electric Company's San Francisco sales force has returned from a successful trip through Nevada.

Thomas Mirk, of Hunt, Mirk & Co., left for Seattle last Tuesday on a steam turbine selling tour for the Westinghouse Machine Company's line.

L. H. Baekeland, junior past president of the American Electro-Chemical Society, attended the convention of the American Chemical Society in San Francisco this week.

S. A. Keith, an assistant engineer at the Humboldt Savings Bank Building steam plant, has just returned to San Francisco from a vacation spent in the Santa Cruz Mountains.

E. O. Wedge has resigned as superintendent of the Consolidated Lighting Company of Montpelier, Vt., to become general manager of the Astoria Electric Company at Astoria, Oregon.

Lee De Forest, a wireless telegraph engineer, has returned from a sea voyage in connection with the installation of a wireless plant on a United States transport service steamer.

V. L. Benedict of the Los Angeles office of the General Electric Company, has resigned to become manager of the Los Angeles Fire Alarm Company, with offices in the Delta Building, Los Angeles.

H. A. Lardner, manager of J. G. White & Co.'s San Francisco office, has been out of the hospital two weeks after a prolonged siege of typhoid fever. He will probably rest about a month before resuming office work.

H. D. Boschken, manager of the California Electrical Construction Company's San Jose branch house, spent a day at San Francisco last week and attended the Electrical Contractors' State Association meeting.

C. A. Tupper, formerly manager of the Allis-Chalmers Company's publicity department, is now actively associated with the Reliance Engineering & Equipment Company at Milwaukee, Wis. He has been succeeded by W. M. S. Miller.

Henry M. Dougherty of J. G. White & Co.'s engineering staff, visited San Francisco during the past week on business connected with the completion of the big dam on the Crane Valley development of the San Joaquin Light & Power Company.

S. V. Mooney, manager of the San Francisco branch of John A. Roebling's Sons Co., who recently returned from a visit to the works reports the eastern wire mills as fairly busy. The Pacific Coast demand for copper wire is rather light.

Willis R. Whitney, head of the chemical department of the General Electric Company, was among the many eminent Eastern chemists who took part in the proceedings of the American Chemical Society's annual meeting at San Francisco during the past week.

F. G. Cottrell, head of the physical chemistry department of the University of California, attended the American Chemical Society's forty-second annual meeting at San Francisco this week and read a paper entitled "The Electrical Precipitation of Suspended Matter."

H. R. King, power apparatus sales manager for the Western Electric Company, is visiting the San Francisco branch, accompanied by F. A. Griffin, the head of the company's commercial department at Schenectady. They are promoting the interests of the new "Hawthorn" line of power apparatus, including both generators and motors.

Among the visiting members from outside points who attended the State Electrical Contractors' Association's meeting at San Francisco last week, were: E. C. Wakeman, Oakland; Mr. Ayres, of Ayres & Stevenson, San Diego; D. T. Griffiths, Berkeley; W. H. McDonald, Los Angeles; W. A. McNally, Pasadena; Mr. Bowers, of Newberry & Bowers, Los Angeles; Mr. Neilson, of Neilson & Smith, Santa Barbara; Mr. Reynolds, of the Reynolds Electric Supply Co., Santa Barbara; C. H. Heilbron, of the Southern Electric Co., San Diego; H. B. Woodill, of Hulse & Woodill, Los Angeles, and J. C. Rendler, Los Angeles. L. R. Boynton attended as director of San Francisco District Local No. 1; J. C. Rendler as director of Los Angeles District Local No. 2; C. V. Snyder as director of Sacramento District Local; Mr. Reynolds as director of Santa Barbara District Local; and W. A. McNally as director of Pasadena District Local.

NEW CATALOGUES.

"Hot Points" for July from the Pacific Electric Heating Company of Ontario, Cal., contains interesting data on "Hot Point" irons.

Bulletin No. 600 from the Sprague Electric Company is devoted to Single Phase and Polyphase Induction Motors of various types and forms.

Sprague Flexible Steel Armored Hose and Couplings are illustrated and described in a booklet from the Sprague Electric Company. These are intended for use with air drills, pneumatic tools, high pressure water and steam.

"Holophane Illumination" for June from the Holophane Co., contains examples of correct illumination and includes the new schedule of prices effective on July 1. Announcement is also made of a new line of reflectors for Mazda and tungsten lights.

American Electric Fuse Company of Muskegon, Mich., have issued their Bulletin No. 350 on Enameled Magnet Wire. This sets forth in easily understood terms the advantage to be gained from using enamel insulated instead of fabric insulated wire, and the complete equipment and facilities which this company has for manufacturing this wire.

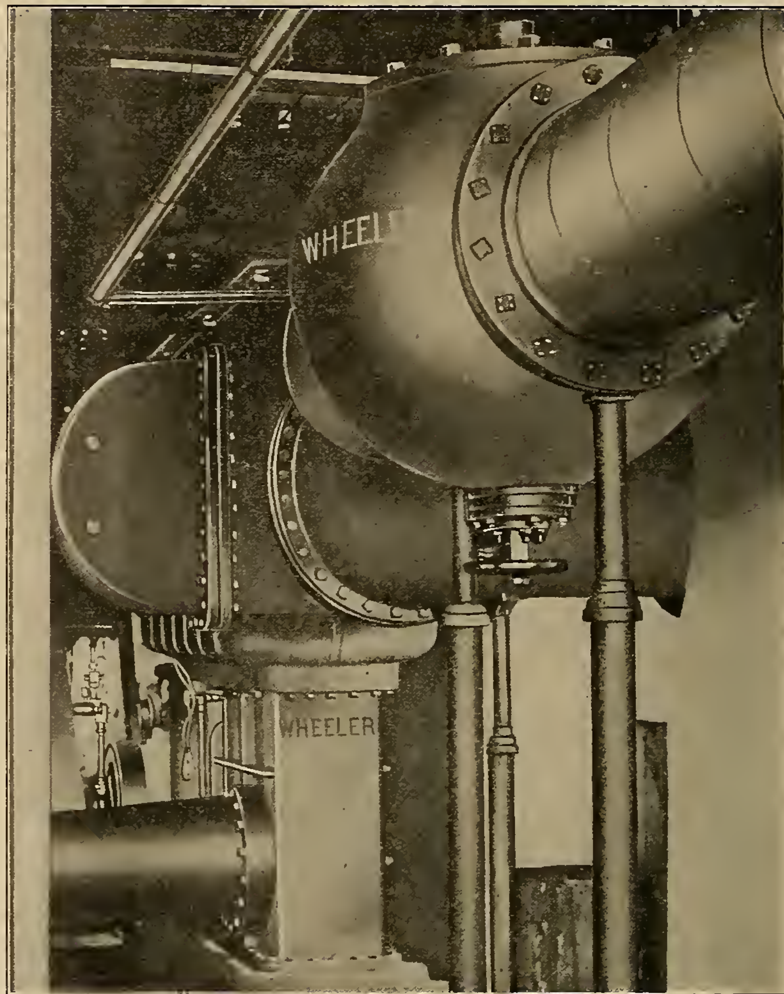
"Battery Charging Rheostats," which has been published by The Cutler-Hammer Mfg. Co. of Milwaukee, describes two types of rheostats for charging ignition batteries and six types for general charging work, for electric pleasure vehicles and for trucks. Full page illustrations of the various types are shown besides several special types such as a motor-generator set panel and a panel for use with a gas engine driven dynamo and storage battery. One section of the booklet is devoted to descriptions and illustrations of protective panels and devices. The applications and advantages of the low current cut-out, maximum voltage cut-out, solenoid switch and overload circuit breaker arrangements are pointed out. These devices prevent overcharging and protect the batteries against damage due to abnormal current conditions.

INDUSTRIAL

A RADICAL IMPROVEMENT IN JET CONDENSERS.

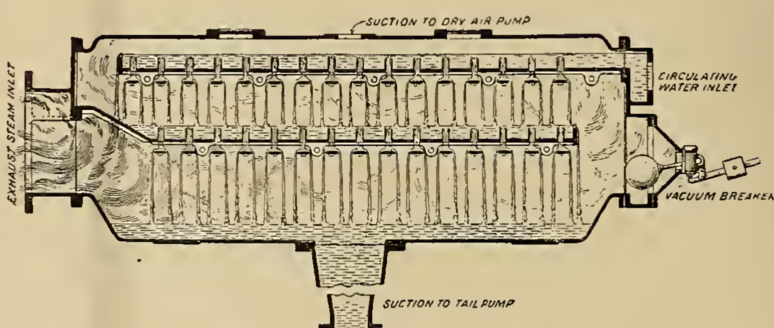
The great impetus which the study of condenser problems has received during the past few years has resulted in the improvement of the surface condenser so that, whereas a heat transmission of 200 or 300 British thermal units per square foot of surface per hour per degree average difference of temperature was formerly considered acceptable, condensers are now built in which the rate of transmission has been raised to 900 British thermal units and even more. The practical results of this are that with the same amount and temperature of circulating water correspondingly less condenser tube surface will be required, or with the same surface, less, or not so cold circulating water, to maintain the same vacuum.

With the jet condenser, it is not so much a question of improving the rate of heat transmission as of insuring thoroughness of intermixture, that is, of bringing each particle of water so intimately in contact with the steam that it will be heated to the steam temperature and its full capacity for absorbing heat realized. This is desirable in order that the amount of circulating water to be pumped and the power consumed in pumping it may be minimized, and in order that the water from the hot well may be more suitable for boiler feeding, since any loss of temperature therein increases the coal consumption at the rate of 1 per cent of coal for each 10 degrees F. that the final temperature of the circulating water falls below the temperature corresponding to the vacuum. In other words, the hotter the water from the hot well, the less will be the steam required in the feed water heater, or the less the coal required under the boiler, if no heater be used.



New Form of Wheeler Jet Condenser.

Complete utilization of the heat absorbing capacity of the water between the temperature at which it is received by the condenser and the temperature corresponding to the vacuum is also to be desired where cooling towers are employed in order that a high vacuum may be realized from comparatively warm circulating water, and further, in order that the water may be delivered to the tower as hot as possible, enabling the latter to get rid of the largest possible amount of heat from a given amount of evaporating surface. Where a condenser is operated in connection with a cooling tower the heat of the steam is transmitted to its final destination, the atmosphere, by two temperature steps, and if the condenser requires a high temperature head in order to perform its work, the less temperature head will there be available for the tower, which will need to be larger in consequence in order to transmit the given amount of heat. If it is a plant already installed, that is, if the amount of tower cooling surface is fixed, it may be necessary to provide the required temperature gradient by raising the upper limit, that is, by having hotter steam in the condenser, which means lower vacuum.



Cross Section of Wheeler Jet Condenser.

A further reason why the design of a jet condenser should be such that it is not necessary to circulate an excess of water over the theoretical amount in order to condense the steam at any stated temperature and pressure is that even though plenty of cold water be available, so that it is not necessary to work close to the temperature limit, the less water used the less will be the amount of air brought in by it to be pumped out again by the air pump. Indeed, with many jet condensers it is found that the vacuum cannot be improved by increasing the amount of circulating water beyond a certain point, due to the facts, first, that much of the additional water does not come into contact with the

steam, and, second, that the air introduced with the extra water more than counterbalances any benefit gained by lower average temperature of the water.

At first thought it would seem an easier and simpler matter to secure high temperature in the circulating water leaving a jet condenser than in that leaving a surface condenser, since in the jet condenser the water and steam come into actual immediate contact, and in view of the fact that open feed water heaters which are virtually jet condensers, are able to heat water to within one or two degrees of the temperature of the steam entering them. Nevertheless, the fact remains that the water discharged from most jet condensers does not rise nearer than to within 10 to 20 degrees F. of the temperature of the steam.

This failure to realize simultaneously the economy of injection water, the economy of power, the economy of heat, and the high vacuum that would naturally be expected from the jet type of condenser is due to several causes, among which may be mentioned the following: First—Faulty design of the condenser head, resulting in insufficient subdivision of the steam and water, so that some masses of water pass through without having come in contact with steam. Second—Some jet and ejector condensers are so designed that the steam will project itself against the water at high velocity, but such high velocity necessarily means back pressure on the engine or turbine. Third—Lack of adequate provision for withdrawing air, including not only air introduced with the steam, but also that carried in solution in circulating water. Fourth—Lack of adequate provision for cooling the air before it passes to the air pump. Fifth—Where air pumps are used, improper arrangement of parts, so that the air pump may receive steam rather than air from the condenser chamber.

We illustrate herewith a new form of jet condenser recently installed in the power house of an electric railway company by the Wheeler Condenser & Engineering Company of Carteret, N. J. This outfit is installed in the basement beneath a Westinghouse-Parsons 1000-kw. steam turbine. The injection water is taken from a creek nearby, and the warm water is pumped from the condenser head by a Wheeler centrifugal pump, driven by a Wheeler vertical engine. Air is withdrawn by a Wheeler rotative dry vacuum pump, while a Wheeler horizontal relief valve provides outlet to atmosphere in case of stoppage of circulating water.

The salient features of this condenser may be observed in the accompanying cross-sectional drawing, which, however, does not show the exact type of hot well installed in the above plant. The condenser head, however, is identical. Referring to the drawing, the water is introduced at the upper right-hand corner into an extended trough or pan, from which it overflows through numerous short tubes, also at the edge on the extreme left, falling into a second and similar pan provided with similar overflow pipes and weir, and finally falling into the lower part of the shell, and overflowing thence to the barometric column or to the centrifugal or other type of pump serving to overcome the atmospheric pressure.

The steam enters through the opening at the left, passes horizontally across through the shower of water, ascends to the second level, passes to the left through the upper shower, and finally all that is left of the steam vapor together with the air, and other gases, passes horizontally to the right, and over the entering and coldest water at the top to the dry vacuum pump suction opening in the uppermost part of the shell. It will be noted that the cross-section of the passage traversed by the steam continuously diminishes as the volume of steam is reduced by condensation and that, therefore, a uniform steady velocity is maintained throughout, leaving no dead pockets in which air might accumulate. Air is nearly twice as heavy as the same volume of steam at the same temperature, and unless swept forward positively will collect in the lowest part of the condenser shell. In surface condensers it is allowable to place the air pump suction at a low point, but not in jet condensers because of the possibility of water being carried over. In order to lessen the size, and work of the air pump, it is also important that the air may, at the last moment, be in contact with the coldest water.

From the drawing it will be seen that it is impossible for any of the steam to pass to the air pump suction without having traversed all of the sprays. The water is finely divided by the small baffles hung below the tubes. In some of the older types of direct contact condensers, the "condenser cone" was substantially an open chamber in which the hot steam would naturally rise to the top while the air would fall to the bottom, the very opposite of the condition sought, for if the air pump receives steam rather than air all its work is for nothing, while the air keeps on accumulating until the vacuum is seriously impaired.

At the right of the drawing will be seen a float controlling a vacuum breaking valve. In case the water level should rise abnormally in the shell, due possibly to stoppage of the circulating pump, this will break the vacuum upon which the inflow of water will cease, since the circulating water is syphoned up to the condenser head from a lower level. The steam would, thereupon, escape through the relief valve.

Tests made on this condenser in actual service show that the innovations introduced by the designers have worked to good advantage. On the day of the test, the barometer stood at 29.9 inches, while the street railway load on the turbine varied from full load to 10 per cent overload. Temperature readings were taken by thermometers placed in the exhaust pipe and in the hot well, while the vacuum readings were taken from a mercury column connected directly to the condenser.

Results of Tests of Wheeler Rectangular Under Type Jet Condenser.

Vacuum.	Absolute Pressure Ins. Mer.	Corresp. Temp. of Exh. Steam	Injection. In.	Injection. Out.	Difference in Temp. betw'n Steam and Cir. Water.
28.65″	1.25″	85.5°	44°	85°	0.5
28.7	1.2	85.	44	85	0.0
28.75	1.15	83.5	44	83	0.5
28.7	1.2	85.	44	83	2.0
28.75″	1.15″	83.5°	44°	80°	3.5
28.75	1.15	83.5	44	81	2.5
28.65	1.25	85.5	44	80	5.5
28.55	1.35	88.5	44	87	1.5
28.75″	1.15″	83.5°	43°	79°	4.5
28.75	1.15	83.5	43	76	7.5
28.6	1.3	87.	43	82	5.0
28.6	1.3	87.	43	82	5.0
28.7	1.2	85.	43	82	3.0
28.65″	1.25″	85.5°	43.5°	82°	3.5
28.75	1.15	83.5	43.5	83	0.5

Although due to the widely varying load on the turbine, it was necessary to set the injection valve to care for the maximum load likely to be carried, it will be noticed that the temperature of the tail water was kept very close to the temperature of the exhaust steam, although due to the coldness of the condensing water available the rise in temperature of the injection water was quite large, and only a comparatively small amount of water was required, a condition unfavorable to close adjustment.

It may be of interest to calculate approximately the ratio of steam condensed to circulating water used. Taking the eighth set of readings, we find a vacuum of 28.55 in. of mercury. Subtracting this from 29.9, the barometer reading, Peabody's Tables, this corresponds to a temperature of 88.5 leaves 1.35 in. of mercury steam pressure. According to degrees F., although the reading of the thermometer in the steam space at the same instant was 90 degrees F. The latent heat of steam at 88.5 is 1042 British thermal units. To cool the condensate from 88.5 degrees F. to 87 degrees F., the temperature of the outgoing condensate, will give 1.5 more heat units, or 1043.5 in all. The entering temperature of the circulating water is given as 44 degrees F., and the

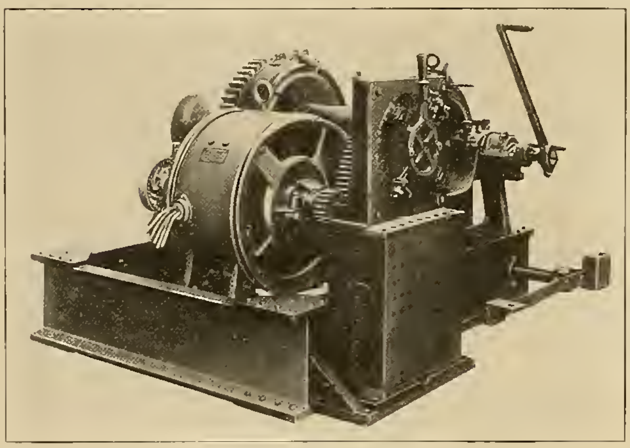
final temperature is 87 degrees F., between which limits each pound of water will absorb 43 heat units. Dividing 1043.5 by 43 we have 24.3 as the number of pounds of circulating water required to condense one pound of steam.

As a matter of fact, the amount would be less than this, since not all of the exhaust is steam when it arrives at the condenser, some of it having already condensed in the turbine and in the exhaust pipe, due to work performed and to radiation. Suppose that 10 per cent of the steam is water, that is, that the quality of the exhaust is .90. Taking 90 per cent of 1042, we have 940, adding 1.5 makes 941.5, and dividing by 43 gives 21.9 as the ratio of the circulating water to steam.

PORTABLE ELECTRIC HOISTS FOR RENTAL.

Novel ideas, when practical, are at a premium. Their speedy adoption and modification to meet local conditions, mark the progressive engineer, the energetic salesman and the growing industry. "Practical novelty" is the key note of all modern enterprise; it has, however, for obvious reasons found a broader exemplification in the electrical field than elsewhere. The accompanying illustration shows a portable hoisting outfit designed by the Rochester Railway & Light Company, and equipped with a Westinghouse motor. The design has proven very effective and has been duplicated for a considerable number of central stations and contractors.

In addition to those already sold, the Rochester Railway & Light Company has retained two completely equipped



Portable Electric Hoist.

hoists in stock for rental to contractors, at a nominal charge of two dollars to cover costs of delivering and installing the hoist. For local service direct-current motors are used. Several alternating-current motors, which can be mounted interchangeably with the direct-current motors, are also held in stock and substituted when the hoists are to be used in outlying districts of the city. No extra charge is made for changing the motors.

The advantages of an electric hoist are numerous and striking. It is compact, durable and self-contained; fuel and water supply need not be considered; the smoke nuisance is eliminated; depreciation at all loads are insured. When equipped with an electric brake, the hoist is absolutely automatic, a single lever giving both power and brake control. In case of interruption to service the electric brake is automatically set, while a mechanical brake actuated by a foot lever affords additional protection. A suitably arranged friction clutch allows the drum to rotate independently of the motor, when lowering the load.

The cost of hoist complete as shown is $800.00
Without electric brake 700.00
Capacity 2000 pounds at 200 feet per minute.

Actual average cost of continuous operation at rated capacity on recent construction, 60 cents per day.

The motor equipment includes d. c. 15 h.p. Westinghouse type S, 1000 r.p.m., back-geared to give a countershaft speed of approximately 230 r.p.m. R-28 controller and resistance; or a. c. 15 h.p. Westinghouse type HF, 1120 r.p.m., back-geared to give a countershaft speed of approximately 230 r.p.m., intermittent service type FA reversing controller.

THE HOLTZER-CABOT SPARK COIL.

The Holtzer-Cabot Electric Company of Boston and Chicago are the manufacturers of a high-tension jump spark coil which is the result of over a year's experiment in an especially equipped laboratory and extensive tests under actual service conditions with several cars of various models in use at the factory.

In addition to those important features, namely, a spark of great intensity and economical battery consumption, the makers have devised several exclusive attachments which greatly add to the value of their coil. It is assembled on the "unit" plan, each unit having knife switch contacts for the primary wires and a spring contact for the secondary connection.

The trouble as well as expense of platinum renewals has been practically eliminated by the introduction of a polarity switch into the coil circuit. This switch performs the regular duty of a starting device and with it two batteries or one battery and a low tension magneto can be used. The principle involved is, that reversing the polarity neutralizes the electrolytic action upon the platinum points and thus will effectually prevent any building up or pitting. This switch, therefore, is doubly welcome to the autoist, as it not only saves many a cash outlay but also guarantees a greater degree of smooth running. The rapid "snap" action in changing over from battery No. 1 to battery No. 2, or from battery to magneto, does away with any chance of the jerk of engine due to misfiring.

A safety spark gap in a glass tube protects the winding and condenser from a discharge, so that a secondary wire if broken cannot work damage to the equipment. The construction of the gap will allow of a means of testing in absolute safety without the possibility of a shock to the operator. Trying out the coil when looking for trouble is reduced to the work of a moment, for by removing the secondary plug contact by a slight pull, if the coil is in working order, the spark will at the proper moment jump across the gap. The means of securing a destructive flame from the coil are besides the general construction of the coil found to a large extent in the high velocity and wide adjustment of the vibrator armature.

All terminals entering this coil are covered by a neat section of the same design as the removable top. The coil itself is worked up complete from the raw material in the plant of the Holtzer-Cabot Company, this including cabinet work and finishing, screw machine work, winding and assembling. A part of the large Brookline factory will be devoted to the production of spark coils and orders are being taken for immediate shipment from stock. The company has just issued a bulletin No. 157B describing their line of magnetos and spark coils.

TRADE NOTES.

Eccles & Smith Co. of San Francisco, Portland and Los Angeles, have been made Pacific Coast representatives of the Cutter Electrical & Manufacturing Co.

The Western Wireless Telegraph Company has installed new wireless telegraph instruments on the Revenue Cutters Bear and McCulloch, which recently left San Francisco for the far North.

It is announced that the Platt Iron Works Co. was the successful bidder for three turbine wheels of over 8000 horsepower each, for the Portland Railway Light & Power Company's extension in Oregon. The contract price is said to be $140,000.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—The Bear & Lick Creek Power Company has been incorporated for $500,000 by S. D. Gosbert.

PORTLAND, ORE.—The Southern Oregon Water Company has been incorporated by W. T. Barnett, E. T. Zork and C. S. Grani with a capital stock of $20,000.

WINLOCK, WASH.—Drew's Prairie Telephone Line Association has been organized to build a farmers' telephone line from the town of Winlock to surrounding farms.

PRINEVILLE, ORE.—The Cone Power Company has been incorporated by local business men with a capital stock of $50,000. W. Booth is the president of the new company.

FINANCIAL.

BANDON, ORE.—The people of Bandon at the city election have voted a bond issue of $60,000 for a municipal water works.

SACRAMENTO, CAL.—Trustee Carragher has presented a resolution to the Board of Trustees calling for a bond election for $666,000 for the erection of a filtration plant to clarify the water of the Sacramento river.

SANTA BARBARA, CAL.—The City Council has paved the way for calling an election for water bonds in the sum of $200,000 by adopting a resolution of intention to this end. The actual calling of an election will follow at another meeting.

EL PASO, TEX.—El Paso is to have municipal ownership of water works. This was decided when 431 voters declared last week that $375,000 in bonds necessary for the purchase of the present plant should be issued while opposing their issuance were 144.

NAMPA, IDAHO.—Bonds of $20,000 for a water works system in Meridian have been received in that place from Otis & Hough of Cleveland, Ohio, and the new system will be started at once. The entire work of construction will be in charge of Edmond Blake, a civil engineer of Boise.

OCEANSIDE, CAL.—City Attorney Johnston has been directed by the Trustees to prepare legal papers for an election to vote on the question of a bond issue for $15,000 for improvement of the municipal water system. The principal item is for the replacement of 8000 feet of wooden main with cast iron.

HUNTINGTON BEACH, CAL.—The City Council has passed an ordinance calling a special election to be held in this city on July 25th to vote on a proposition bonding the city for $2000 for purchasing land upon which to erect a gas plant and $37,500 with which to erect the plant. Bonds will bear five per cent interest per annum.

VALLEJO, CAL.—The City Trustees have voted to call an election to submit to the people propositions for bonding the city for $90,000, for improving the water system and $75,000 for the city's share of the joint city hall and branch county jail for which Solano county has given $50,000. Propositions to bond the city for installing and operating an electric light plant and for an intersecting sewer were defeated.

SPOKANE, WASH.—S. Z. Mitchell, president of the Electric Bond & Shares Company of New York, the financial subcorporation of the General Electric Company and allied electric interests, has obtained an option on a controlling interest in the Hanford Irrigation & Power Company of Seattle, for a consideration said to be close to $750,000. The Hanford company owns valuable water rights on the Columbia river at Priest Rapids, where there is sufficient power to generate 100,000 electric horsepower.

TRANSMISSION.

SPOKANE, WASH.—Work on the 2000 foot tunnel project under the Spokane river has been started by the Washington Water Power Company.

VICTORIA, WASH.—A favorable report was received on the extensions of the Stave Lake Power Company and the company's plans approved.

REPUBLIC, WASH.—The North Washington Company, which owns and operates the power plant at this place, has leased the plant at Oroville and will build a 45-mile power line to this place.

MARICOPA, CAL.—The West Side Electric Company of this place have interested eastern capital and have resumed operations after a three-months' shut down. They expect to furnish electricity for both lighting and pumping purposes in the West Side fields.

ELLENSBURG, WASH.—The Cle Elum Falls Power Company has filed a water right with the county auditor, appropriating 5000 cubic inches of water per second from the Cle Elum river to be used in producing power. J. C. Donnelly of Tacoma is president of the company.

LONG BEACH, CAL.—Another contract for work on the new plant being erected on Long Beach harbor by the Southern California Edison Company has been awarded to the Weber-Duller Company of Los Angeles. This contract is for all chimney work connected with the big power plant.

LOMPOC, CAL.—The Pacific Coast Ltd. Oil Company has installed an electric plant for the treatment of oil to separate the water from the oil. The installation is under the supervision of Professor Wright of Berkeley, who is the inventor of the system. If such an invention proves a success it will be a boon to oil operators who have a large amount of water in the oil.

CHIHUAHUA, MEX.—The Mayo River Power & Land Company of Denver, a corporation organized with a capital of $5,000,000 U. S. currency, to develop hydroelectric power on Mayo river in western Chihuahua and eastern Sonora, and for which it acquired a federal concession over a year ago has its hydraulic engineer R. M. Jones and his assistant examining several rivers in Sinoloa. The first dam location has been made and plans and specifications of the dam and power plant have been made.

WASHINGTON, D. C.—Ten withdrawals of water-power sites in California were made by President Taft in the orders from Beverly a week ago. The affect strips of land along the Pitt, Susan, Yuba and North Fork of the Feather rivers in Northern California, the Stanislaus, Mokelumne, Tuolumne, Fresno and Kings rivers in Central California and the East and West Walker rivers in the Mono Lake region. The area of land withdrawn totals 47,819 acres. These withdrawals are of public lands outside the national forests.

SAN FRANCISCO, CAL.—Everything of value belonging to the Sierra Nevada Water & Power Company, operating in Calaveras county, has been sold by Sheriff Joshua Jones for the benefit of creditors of the defunct Market Street Bank of San Francisco and unpaid laborers at work on the company's projects, for $14,000. The return of the sale, together with the payment of the receipts therefrom, to the legal representatives of Milton Bernard, assignee, was made to the Superior Court today. It marks the end of a long legal battle, and at the same time gives to the laborers about $6000 that they have been waiting for for nearly a year.

PROFESSIONAL DIRECTORY

ILLUMINATION.

MEDFORD, ORE.—J. R. Anderson purchased a tract of land about a quarter of a mile south of Voorhies on which to erect his gas plant to supply Ashland and Medford.

LOS ANGELES, CAL.—The Board of Supervisors has passed an ordinance granting a franchise to the Domestic Gas Company to lay gas pipes in certain public highways in this county.

EUGENE, ORE.—Chief Engineer H. H. White of the H. H. Byllesby company's gas plants, announces that the company expects to put in seven miles of additional gas mains in this city.

LOS ANGELES, CAL.—The Gas & Electric Co. (Baker Iron Works, contractors) will erect two 5-foot gas distributing drums complete, at the compressor station at Jackson and Ducommun streets, Los Angeles.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company has specifications out and is calling for bids on new apparatus for its gas plant. These specifications cal' for new gas generator and a new 200,000 foot gas holder, also several miles of 10-inch and 12-inch pipe to increase the serving capacity of the mains.

TRANSPORTATION.

WHITE SALMON, WASH.—C. M. Wolfard is promoting an electric railway for this section to be about 60 miles in length.

ST. ANTHONY, IDAHO.—A scheme is on foot, promoted by the Commercial Club, to build an interurban line from this place to Parker, down on the bench to Egin, etc. Over $12,000 has been subscribed toward the project.

PORTLAND, ORE.—Bids have been requested for the construction of 50 miles of line for the United Railways Company from Glencoe to Bay City. Only certain contractors were asked to bid. A contract was let to Porter Bros. for 11 miles of road from Burlington to Glencoe. The contract for substation equipment was let to the Westinghouse Electric Company.

OAKLAND, CAL.—An ordinance granting the San Francisco, Oakland and San Jose Consolidated Railway a franchise to 1000 feet of the western waterfront for wharves, docks and terminal facilities, has been given its final passage by the City Council. In the near future the company is expected to begin the work of improvement, upon which it will expend in the neighborhood of $5,000,000.

LOS ANGELES, CAL.—Grading on the proposed Pursell electric road right of way has begun. The road is to run from San Diego to Escondido. The work now consists of the leveling to the road bed of the old belt line railroad in the city park at San Diego along which the right of way of the new road now extends. The franchise provides that the road must be completed to El Cajon within 1 year and to Escondido within two years after the work is commenced.

SAN FRANCISCO, CAL.—T. M. C. Flannery and W. Flannery, stockholders in the Western Rapid Transit Company, charge a number of the other stockholders with misappropriation of the company's funds in a suit filed with the county clerk last week. The defendants are R. A. Crothers, A. H. Hayes, Horace Wilson, Wm. Wilson, Jas. S. Murphy, G. O. France, N. L. Wilson, D. L. Crosbie, H. M. Wright, W. P. Twist, Lilian G. Twist, G. Stevens, L. M. Fairchild and J. I. Plunkett. The entire capital of the organization is $250,000. Over $200,000 has been paid into the treasury, it is claimed and misappropriated by the incurring of debts said to be contrary to the statutes. The plaintiffs particularly object to an alleged transfer of the company's property to corporations outside of the State. An accounting is demanded.

WATERWORKS.

JOSEPH, ORE.—Bids will be received by the city of Joseph, Ore., until 8 p. m., July 20th, for the construction of a water works system for Joseph, Ore.

BAKERSFIELD, CAL.—By unanimous vote the electors of the Standard School District have voted $8000 for the improvement of the school. A water system will be installed, playgrounds improved and added to and the money used for the betterment of the school in every way.

LONG BEACH, CAL.—The City Council passed an ordinance granting to F. A. Green the right and privilege for a period of 21 years to take water for cooling purposes from the entrance channel of Long Beach harbor and to discharge the water when used into the ocean, and for that purpose to operate and erect a conduit.

SPOKANE, WASH.—Bids in triplicate will be received at the office of the Constructing Quartermaster, Fort Missoula, Montana, until 9 a. m., July 30, for the construction of a water distributing and sewer system to be received separately or jointly, addressed to B. Shattuck, Fourth Infantry, Constructing Quartermaster.

GILROY, CAL.—County Surveyor J. G. McMillan has been called here by Supervisor H. S. Hersman for the purpose of running levels from the Goodrich place on the Old Hot Springs road to the Hecker ranch on the Ferguson road, a distance of about three and one-half miles. This is done with a view of putting in a water system and supply water.

LIBBY, MONT.—G. Stanton, E. Barnum and C. Proctor of Great Falls have been in Libby for several days with the intention of securing a franchise to put in a gravity water system. They also wish to secure an electric lighting franchise, and are negotiating with the telephone company to take over the telephone franchise granted some months ago.

BELLINGHAM, WASH.—A petition presented to the water board by C. O. Greenfield asking for the installation of a water main from the present city limits along the Guide Meridian road, has been granted. It is estimated that a main 632 feet long would be required for this service at a cost of about 25 cents per foot and that the entire cost of the new main would mean approximately $200.

SAN FRANCISCO, CAL.—Sealed proposals in triplicate for constructing a reservoir wooden tank, extending mains, etc., at Fort Barry, Cal., will be received here up to 11 a. m., August 6, 1910, and then opened. Plans, specifications, blanks and necessary information can be obtained here. A deposit of $10 is required to insure return of plans, etc. Envelopes containing proposals, to be marked "Proposals for reservoirs, etc., Fort Barry, Cal.," and addressed to Major George McK. Williamson, Quartermaster, U. S. A.

SAN JOSE, CAL.—Argument in the case of the Hayes-Chenoweth Company against the Bay Cities Water Company, an action in which the plaintiff is attempting to restrain the water company from appropriating the waters of Coyote Creek, has begun before Judge Welch. Attorneys John E. Bennett and C. D. Wright for the water company ask leave of Judge Welch to amend their pleading, so that the case will cover the excess waters of the river instead of being so broad as the former suit. It is argued on the part of the water company that no injury would be done the orchardists who have artesian wells along the river, which affects to a greater or less degree every well in the Santa Clara Valley, should the water company only use the excess flow and not touch the large volume of water that percolates the gravel and furnishes the supply for the many artesian wells of the valley. Judge Lieb for the plaintiff, on the other hand contends that should the water company be allowed to use the amount of water that it claims it has a right to appropriate it would affect every well in the valley.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 4 | SAN FRANCISCO, JULY 23, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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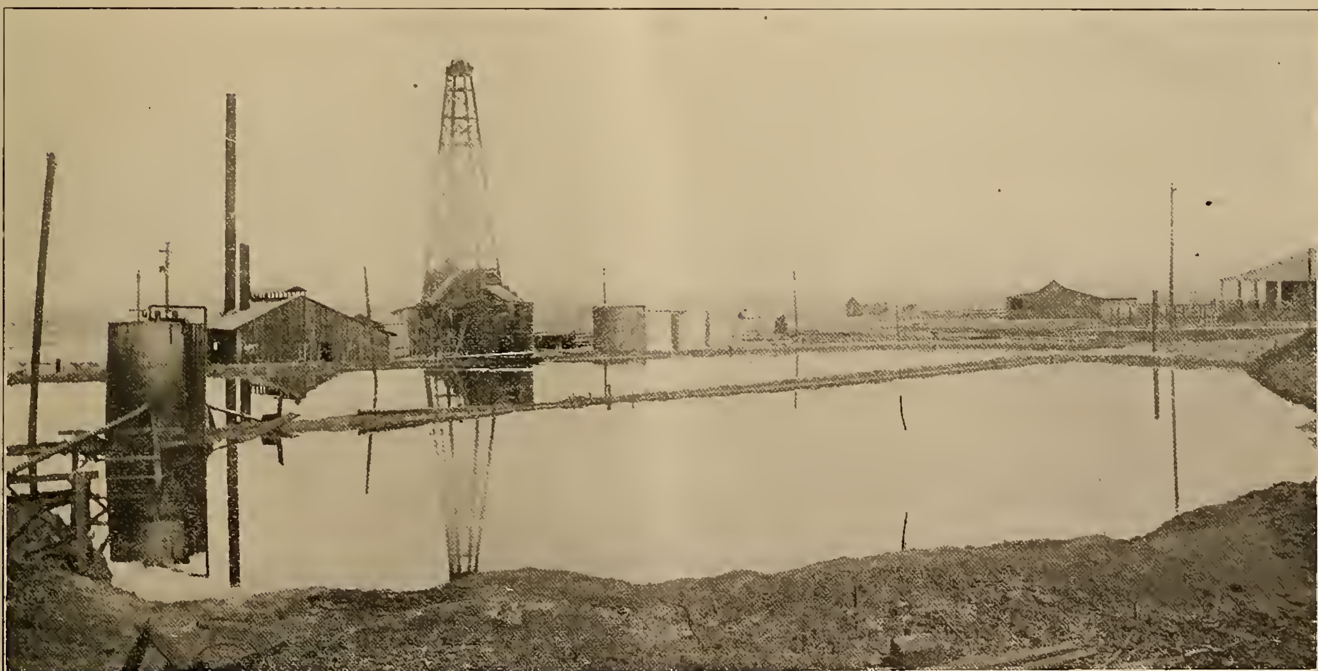
VOLUME XXV SAN FRANCISCO, JULY 23, 1910. NUMBER 4

ELECTRICAL DEHYDRATION OF OIL

In many of the oil fields of California there are great pools of oil containing such a large percentage of water as to be unmarketable. This water was usually introduced in pumping and heretofore all attempts to separate it from the oil have failed. Some of these great pools contain hundreds of thousands of gallons of oil that have stood for three or four years. The specifications usually limit the water content to a maximum of two per cent or thereabouts. These emulsions contain all the way from ten to eighty per cent of water and have therefore been practically useless and have constituted one of the greatest economic wastes in the oil industry.

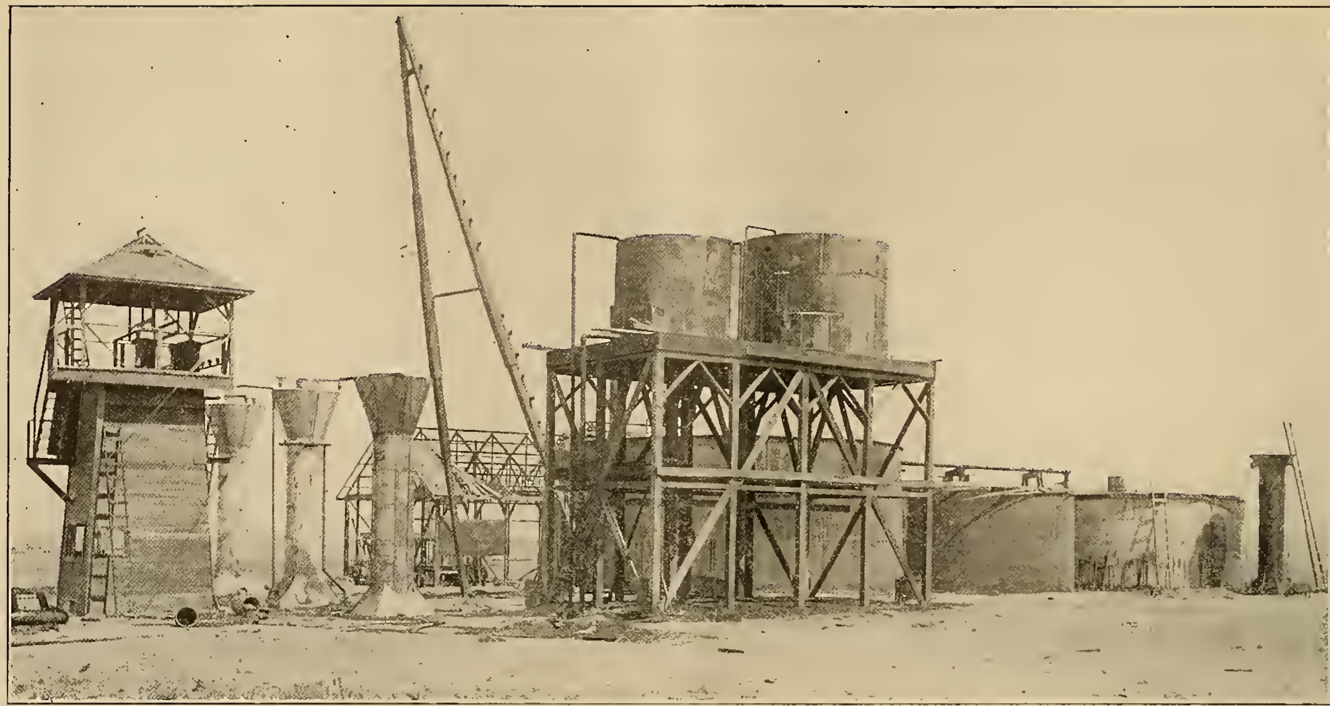


Pool of Waste Oil and Water in Coalinga District.

One of these pools which stood for years in the Coalinga district is illustrated on this page. The oil in this lake, however, has since been treated by a new process and it no longer stands. This process is a special application of a method for the electrical precipitation of suspended matter, recently patented by Dr. E. G. Cottrell, professor of physical chemistry at the University of California.

At the meeting of the American Chemical Society in San Francisco, July 12-16, 1910, Dr. Cottrell explained in detail the application of this method to the elimination of the obnoxious gases in smelter smoke, incidentally referring to the further application of the same principles to the dehydration of oil. Through his courtesy and that of his assistant, Mr. Allen G. Wright, we are enabled to present herewith illustrations of the apparatus now being used in the California oil fields. This process, which treats the oil at a cost of about one cent per barrel, should prove a great boon to the oil operators of the State, for it makes salable a former waste product now worth thousands of dollars.

The material to be treated is an intimate mechanical mixture of oil and water. The water particles are surrounded and held apart by films of oil which are so tenacious that they cannot be separated by mere mechanical agitation. Laboratory experiments show that by subjecting such an emulsion to the influence of a high voltage alternating current, the minute water particles are agglomerated and sink to the bottom of

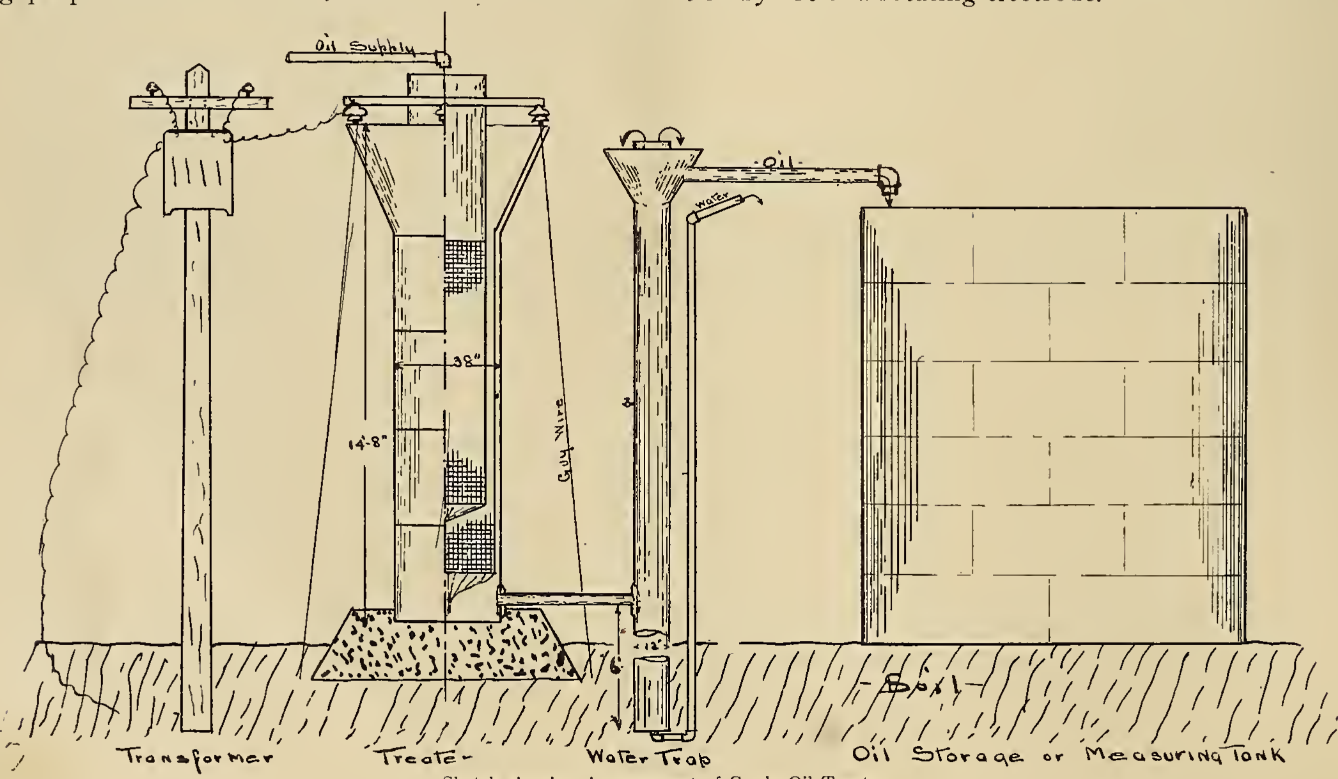


Plant which Treated Oil in Pool shown on First Page.

the containing vessel, being heavier than the oil.

The treating apparatus is essentially a huge Leyden jar whose disruptive discharge penetrates the oil film and allows the water particles to run together. This phenomena was observed in a high power microscope and is probably the best explanation of what actually takes place. In practice an alternating current is stepped up through a transformer to about 10,000 volts. The oil is delivered to the treater, and, as shown by the accompanying sketch, passed on to the storage tanks, the precipitated water being carried off at the bottom. It is an interesting fact that this water is used in preference to the regular supply for washing purposes in the district.

The plant illustrated has a capacity of 500 barrels per day and in a five months' run treated all the oil shown in the illustration on the first page, gaining therefrom 75,000 barrels of marketable oil. This oil formerly contained 14 per cent of water, which was reduced to less than two per cent. A plant is also being installed in the Santa Maria fields at one of the wells of the Pacific Coast Limited Oil Company. This handles 1000 barrels daily of oil containing about 25 per cent of water. The line current at 22,000 volts is stepped up to 10,000 volts and experiments show that it requires about 1-7 of a kilowatt hour per barrel of oil treated. It is expected to further reduce this consumption by use of a rotating electrode.



Sketch showing Arrangement of Crude Oil Treater.

THE CHURCH AND TECHNICAL EDUCATION.[1]

BY G. W. DICKIE.

What has the church to do with technical education? Certainly in the past the protestant church has had little connection with the technical training of its own people. I sometimes think that in this statement is expressed the reason why such a large proportion of the technical men of this generation are outside the church.

It is only within the last fifty years that technical knowledge has become of necessity a distinctive feature of modern education. The accumulation of experience in dealing with the forces of nature is one of the characteristic distinctions between man and all other created beings. This faculty endows him with a power which has been given him not that he might be independent of God's revealed will, but that he might be able thereby to help in the working out of that will and thus become an intelligent and efficient agent in the consummation of the grandest and most beneficent purposes of the Creator.

The knowledge of nature's laws which Christian men call God's laws is a branch of education that the church cannot afford to neglect. Perhaps no branch of human knowledge needs the influence of the church more than does technical education. It deals with material things; it needs protection from materialist tendencies.

Imparted at a time when the mind of youth is in its most receptive state, technical education, dealing with the material universe and its utilization, tends to crowd out the spiritual, and unless the mind is taught at the same time to refresh its power in the contemplation of the infinite, the man will be developed simply as a worker among the forces of nature. He will hear no music in the waterfall except the din of wheels that he can make it set in motion; he will see no grandeur in the thunder cloud or lightning flash except the visible evidence of a power that is everywhere, that he has found how to condense and transform into a means of transmitting his thoughts to the farthest parts of the world, that he can carry to the cities to make them brilliant with light and vibrant with power.

Can the churches that are supposed to be the central stations of spiritual power afford to see the best mental material of the new generations turned away from all religious influence and devoted entirely to the application of natural forces to the satisfaction of the physical wants of mankind? I think not. That she may combine with technical training that moral and spiritual teaching which will prevent the pupil from degenerating into a mere adapter of nature's laws to some end in view, that she may help develop him into a man with nature as his instrument and the God of nature as the supreme power of his life, is why the church is vitally interested in technical education.

The reason why the spirit that animates the church that teaches the meaning of the spiritual laws of God's universe should be the same spirit that animates the institution, wherever it may be, that proposes to teach the meaning of the natural laws that govern the material universe, is that the spiritual and the natural laws are ultimately the same, originating in the same lawgiver, and that life which is not lived in accordance with both is incomplete. They differ in this, that the knowledge of nature's laws comes to us by the exercise of those faculties with which we are endowed, while our knowledge of spiritual laws comes by acceptance, by revelation. The essentials of religion cannot be cultivated like other branches of human knowledge and experience. Religion is not a progression of accumulated facts, one leading into another as one proposition in geometry follows out of another, making a progressive science gradually built up and acquiring greater scope.

High as man is placed above the things and creatures around him, there is a higher, a more exalted position within his vision. The ways are infinite in which he occupies his thoughts in regard to the fears, the hopes, and the expectations of a future life. Now, I believe that the truth relative to that future cannot be brought to his knowledge by any cultivation of his mental powers, however well he may be endowed in that way. Such knowledge, if it comes to him at all, will come through other teaching than his own and will have to be received through simple belief in the testimony given.

I would not have you suppose for a moment that the self-culture I have so often recommended in respect to the things of this life, can be extended to embrace the essentials of religion, as if a man by reasoning could find God. I must therefore claim an absolute distinction in this respect between the essentials of religion and the essentials of human sciences or mental cultures. I might be reproached with weakness, if nothing worse, by refusing to apply those mental operations which I think good in respect to high things, to the very highest things. I am quite content to bear any such reproach. I have never seen anything incompatible between those things which can be known and demonstrated by the mental powers with which man is endowed and those higher things concerning his eternal future, that he cannot find out by any exercise or culture of those faculties and which he must accept as a child does an inheritance.

The church has not been alive to the need of technical education to deepen and brighten the teaching of its great and universal text book. Under her guidance, a new order of manhood might be produced who would know and feel that—

> "To matter and to force the all is not confined.
> Beside the law of things is placed the law of mind.
> One speaks of rock and star and one within the main,
> In unison at times and then apart again,
> But tell of one who brought us thither
> And holds the key of whence and whither.
> The sequence of law we learn through mind alone.
> We see but outward forms, the soul the one thing knows,
> If she speaks truth at all the voices must be true
> That give to visible things their laws and honor due
> But tell of one who brought us hither
> And holds the key of whence and whither.
> God in his science tells what no known laws foretell,
> The wandering stars and fixed alike are miracle,
> The common death for all the life renewed above,
> Are both within the plan of that all-circling love.
> The seeming chance that brought us hither
> Accomplishes his whence and whither."

1 Lecture delivered in a San Francisco Church.

What we need in our technical schools of to-day is a recognition of the spiritual needs of the scholar. When these needs are felt we will have reverent students of God's universe and that will bring into the profession nobler characters and into the church a strength that will enable her to accomplish the great work of which she is now only beginning to see the possibility.

We ought in our search through the treasure house of nature to be lead by the "Pillar of cloud by day and the pillar of fire by night," as surely as the old Hebrew emigrants from Egypt were, if we are ever to reach our promised land. That old story tells us that the Lord went before by day in a pillar of cloud to lead them on their way, and by night in a pillar of fire to give them light to go by night as well as by day. "He took not away the pillar of cloud by day nor the pillar of fire by night from before the people." That has always been a fascinating wonder to me, and looking back upon the twilight wonders of this old record I find that the most remarkable fact in the experience of these ancient emigrants was undoubtedly that God Himself went before them in this visible way. I can imagine the awe with which they looked upon what they believed the visible presence of God and what an interest they would feel in that wonderful cloud. I have often pictured that occasion when "The cloudy pillar descended and stood at the door of the tabernacle and talked with Moses, and all the people saw the cloudy pillar stand at the tabernacle door; and all the people rose up and worshiped, every man in his tent door; and the Lord spake unto Moses face to face as a man speaketh to his friend."

It is not necessary for my present purpose, which is not that of merely preaching a sermon, to separate that which is spiritual from that which is material in this wonderful manifestation to those Hebrew emigrants. The spiritual part of it is represented in the history of every true man who is lead, often by devious wanderings, for some forty years or more through a wilderness of varied experiences till he comes at last to the waters of Jordan. He has had realizations of the presence of God in the daytime of his life experience when he could almost see the cloudy pillar leading the way, though he could not understand the mystery of it—a cloud that joined earth and heaven. Then in the dark days of his experience and night times of ignorance and helpless inability his idea of God is not that of the cloud, but something more vivid—a fire giving light, but inapproachable—a consuming fire. This story is ever true in man's mental and spiritual experience.

If you want your young man to know something of the material realization of this cloud, show him our great ocean greyhounds which are carrying nations of emigrants across great sea deserts from old homes to new lands of promise. Have they not their cloudy pillar by day and their pillars of fire by night continually ascending that they may go by day and by night? In that cloud also God has a material presence that can be realized by those who are searching for Him, and it is the business of the church to teach the ear to hear and listen to the voice that comes from that cloud—for he who so listens will not fail to recognize that voice to be "The voice of the Lord speaking face to face as a man would unto his friend." It is that those who come to know of the nature of this material cloudy pillar may also learn to know and feel something of the living presence of the God of nature, that the technical schools need the support and guiding hand of the church.

The earnest, thoughtful student, as he comes near to this cloudy pillar will hear a voice speaking to him just as distinctly as Moses heard it. The voice of the cloud will tell him of a time in the distant past, millions of years before there was a man on the earth, when he had a friend working for him, the same friend who speaks from the cloudy pillar; that he anticipated the coming of man, who should be his heir upon the earth and should bear his likeness; and provided everything necessary to maintain that dignity. These things were laid up for him in deep storehouses that some day he would, by the key of knowledge, be able to open, and find material force and power, petrified into preserved blocks of almightyness. When he learned to bore through the rocks he would find liquid power, the possession of which would make him mighty beyond all creatures of the earth. He also learned something of the ways of this great friend whose voice is in the cloud, this grand past master of all nature's laws and of all sciences; something of how he carried out this design for his future friend by planting immense forests of gigantic pine and free fern, and forced their growth by making conditions of heat and moisture more favorable to vegetation than any that have since existed. Then he let torrents of mighty rivers break from their ice-bound channels and hydraulicked out those mighty forest giants, carrying their huge trunks down the water courses to be entangled in the jungle growth he had prepared at the river mouths. These in the course of time he submerged, to be silted over with rock worn soil of ages. Then he lifted them up and repeated the forest and its destruction. This process he enacted again and again, concluding by putting the pressure of worn-down mountains upon the huge mass, holding it there for ages until the great forests, the peat mosses and the jungle were changed into hard black coal. At the same time he was working in his great laboratory condensing hydro-carbon gases from the by-products of his great operations and collecting them in rock-bound cisterns, where they have been held captive for ages, until his friend man found out how to uncork them and let this concentrated power gush out. Think what condensed power is in the coal beds and what sealed-up dominion is in the oil cisterns. Consider the mighty things that are being accomplished around the million altars whence continually ascend these modern cloudy pillars.

Consider our locomotion by sea, on the earth, and in the air. Are we to teach our youth that because we have discovered the combination of the lock that has kept this great power from men of past generations, these treasures are ours? It is not so. Our friend who speaks from the cloud says to us in reference to these modern wonders of locomotion, just as he spoke to the old Hebrew pilgrims, "I bore you on eagles' wings and brought you unto myself; now therefore, if you will obey my voice, indeed, and keep my

covenant, then you shall be a priceless treasure unto me above all people, for all the earth is mine." What was the crossing of the Red Sea on foot compared to our modern miracles? Surely with far more emphasis can the phrase "I bore you on eagles' wings" be applied to our modern experience, to the civilized nations of the earth, and especially to those who have the power of eagles' wings, which are now an accomplished fact through the instrumentality of liquid fuel and the internal combustion motor. It may, I think, be inferred with equal surety that the reason or purpose of His having put all this power in our hands is as He has said of the ancient "chosen people," that He might bring us unto Himself to be a peculiar treasure unto Him above all people, for all the earth is His, all the nations of the earth are His treasures, and they who obey His voice are His peculiar treasure.

We must teach our youth to believe in miracle and to recognize the miracles of our time in their true magnitude. The ancients of every nation, especially those through whom we have the Bible, delighted to throw up to the surface of their records the golden weft of miracle that, crossing the warp of fact, makes up in every age the web of history. In our age we do all we can to hide the weft thread which is in the web and throw to the surface only the pile of the straight, natural warp. This is surely an error, for it hides from us much that is beautiful and inspiring around us and that was undoubtedly meant for the gratification of the highest functions of our spiritual natures. This has led us in our pride to judge the ancient races of man by the same standard we set up for ourselves, so that we often seek to accept as matters of sober fact what they have worked into their records as figures of speech and poetical imagery. Much that we are told in the Bible of the Hebrew people may be the story of historical and noble deeds sung at times into the poetry of miracle. For instance, Moses appears before Pharaoh with a petition written by his friend Aaron on a scroll of papyrus wound upon a staff or rod. He lays this before the monarch, demanding at the same time the liberation of his people. He has cast his rod before Pharaoh, who is stung to the quick, as we would say. Moses says the rod became a serpent. The king calls a council of his wise men and each of them prepares an answer and presents his scroll wound upon a rod. None of them can withstand the force of Moses' argument and the result is thus described: "They cast down every man his rod and they became serpents, but Aaron's rod swallowed up their rods."

Let me now, with a little of the spirit shown by this ancient people, which is the spirit which should animate the teaching of every technical school, search in this modern cloudy pillar for those golden threads of miracle that are there, as in every object of nature interwoven with purely material substance.

The object of the "Pillar of cloud" and the "Pillar of fire" was that the people might go by day and by night. They could not do that long, for they were often in need of rest. Our pillar of cloud is raised also that people may go by day and by night, but without effort on their part and even while they rest, for their floating tabernacles, or rolling cars, and soon, possibly, flying carriages, are pitched on eagles' wings. While the sleeping pilgrim crossing the ocean desert draws one breath he and his couch are borne a distance of two hundred feet through ocean billows split by an iron wedge twenty thousand tons in weight, whose speed exceeds two thousand feet per minute. Whence comes this miracle of power? What is the secret of that altar service whose incense is the "Pillar of Cloud"? That which propels the great steamship on the sea, the trains on land, the automobile on streets and roads, the car on wings that cleaves the air, which pumps and grinds and spins and weaves, and by the spirit of fire and water everywhere makes man omnipotent, is the power of combustion in the material world and sacrifice in the spiritual world.

Consider the smokestack of the ocean liner. It is fifteen feet in diameter. Every minute ten tons of burnt fuel—coal and air—pours from it with a velocity of one thousand feet per minute. It seems impossible that any steamer could carry such a large quantity of fuel as to allow of her burning ten tons per minute. It is not carried. Our friend who speaks from this cloud separated the materials of combustion for us millions of years ago and laid up for us only the essence of fuel. Only five per cent of the total weight of the fuel has thus been preserved, and this much alone has to be carried for fuel in the form of coal or oil. The other ninety-five per cent of the fuel is delivered free on board by our friend who speaks from the cloud without freight or cost at any part of the ocean. The steamship at sea or the locomotive on the land does not need to stop or slow down to take it on board and the finest dress of any of the lady passengers will not be soiled by its dust. It comes on board in the form of pure fresh air, finding its way down the hatches and ventilators to the fire room without any direction or assistance, although it has never been on board the vessel before, and in about ten seconds of time it is out again at the top of the smokestack. It has done its work like all the work that is done for our friend of the cloud—quietly and well.

A divorce effected millions of years ago between carbon and oxygen has in these few seconds been cancelled and the parties have been reunited and are now rushing out on their marriage trip with a speed of a thousand feet a minute. Not very like a wedding you will say, judging from the hue of the procession. They have simply donned their traveling robes. Their gay trousseau is all packed. But they have with them all the bright hues admired by the ladies of to-day. All the colors of the beautiful flowers, plants and trees are there hidden from sight for a time. Some day when you are admiring the beautiful colors of some radiant blossom think how it may once have been an atom of smut in the curling cloud above some factory chimney. This is a miracle. You may have seen a brass founder stirring among a heap of brass chips and dust with a magnet to find the little bits of iron that may be hidden in the brass. In this way the myriads of green leaves in every forest and field are waving like magnet searchers in the atmosphere, fishing, as it were, for the molecules of carbonic acid gas, and when one of these comes along out of some pillar of cloud perhaps many miles away, it is seized by the living leaf. Leaves are the opposite of our boiler furnaces. The leaves seek carbon, not oxygen, from the air. Each leaf holds up its captive atom to the

sun and from that origin of power, the same friend who speaks to us from the cloud, using as his instrument a ray of light ninety-five millions of miles in length, picks out the oxygen from the carbon in each molecule of gas, liberates the oxygen for the health and comfort of man, and imprisons the carbon for the health and beauty of the plant. Here is a wonder miracle, something that man has been unable to accomplish in any instance by all his laboratory contrivances or electric currents. He has not succeeded in separating one molecule of carbonic acid gas into its constituent atoms—carbon and oxygen.

Now, when we consider that not only our happiness, but our very life, depends on this separation being effected, and that our friend who speaks to us from the smoke cloud alone can do it, and that He is continually at work operating with millions and millions of needles of light each ninety-five millions of miles long, picking these carbonic acid knots for us with one hand while with the other He keeps turning the world round to bring successively every leaf of every plant on the surface of the earth under the points of these magic sunbeam needles, do we not feel ready to acknowledge the miracle and to think that if we are to cast off our shoes wherever there is holy ground we should never have shoes on our feet again, for His presence sanctifies all work and every spot. "Canst thou by searching find out God, canst thou find out the Almighty unto perfection?"

Searching in the smoke we have found the seams of coal, the oil deposits and the forests of a hundred ages ago dove-tailing with a nice fit into the atmosphere of to-day and every leaf on forest and field dove-tailing into the atmosphere, and man with his busy hand and brain dove-tailing into them all. We have been searching for the Almighty. We hold up as much of one of his puzzles as our limited skill has enabled us to put together and looking at it say, "Lo, these are parts of His ways, but how little a portion is heard of Him. But the thunder of His power who can understand."

It is, I think, to be concluded from any careful investigation into the correlation of the material and the spiritual, that we reverently bring our youth from the sanctuaries of His spiritual presence to the portals of that great temple where He speaks to those who desire to hear Him through the medium of the material world in which we live and do the work He has given us to do.

Examination for first-class steam engineer is announced by the United States Civil Service Commission on August 10, 1910, to fill a vacancy in the position of chief engineer, $1600 per annum, in the United States Postoffice, Custom House, and Court House Building at Cleveland, Ohio

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Examination for second-class steam engineer is announced by the United States Civil Service Commission on August 10, 1910, at the places mentioned in the list printed hereon, to secure eligibles from which to make certification to fill two vacancies in the position of assistant engineer, $1200 per annum each, in the United States Postoffice, Custom House, and Court House Building at Cleveland, Ohio.

HISTORY OF GAS LIGHTING IN MARYSVILLE.

BY E. C. JONES.

E. C. Jones.

Marysville, named in honor of Mary Murphy, one of the few survivors of the ill-fated Donner party that arrived in California in 1846, was the third place in California to introduce illuminating gas. During the pinoeer mining days Marysville was one of the most important towns in California. It is situated almost at the geographical center of the Sacramento valley, on the east bank of the Sacramento river, near the confluence of the Yuba and Feather rivers. Because of its location it was the natural source of supply for the miners early operating along the Yuba and Feather rivers. The large population and the richness of its tributary mining district established Marysville as a town of importance.

When red-shirted miners by the thousands were working in the placer diggings in the foothills to the eastward, Marysville was a big place with a population as great half a century ago as its 5000 of today.

It is a flat town, protected along its river side by a 20-foot embankment to ward off the menace of high water during the rainy season.

First Marysville was all for the miners, but when mining began settling to a system of fewer individuals and more machinery, and agriculture grew to be a greater and greater prospect in California, then Marysville became the storm center of that historic legal struggle between the hydraulic miners in the foothills and the farmers in the valleys, where the navigable streams were being slowly but surely made shallower and shallower by torrents of mud from the hydraulic mines. Marysville found herself in the middle of a rich, level, agricultural area of vast proportions.

The farmers were becoming more numerous than the miners, and they were doubly interested in preserving the depth of the river channels, because of the commercial advantage of having water transportation to compete with railroad rates and because of the necessity of maintaining a channel of sufficient depth to avoid the certainty of ruinous inundation by high waters and the covering of the adjacent farming lands with a deposit of "slickens" from the mining regions.

Today Marysville is an old town still young. The buildings in its business section and some of its sidewalk signs proclaim an origin dating back half a century, and the styles, created when miners' money was dominant, have not been changed much, though Marysville has become a commercial center of farms and orchards, and has within its own limits machine shops, foundries, sash and door factories, flour mills, woolen mills and canneries.

In 1857, the success of gas making in San Francisco and Sacramento having been assured, proposals were made to the common council of Marysville relative to lighting the city with gas. Charles H. Simpkins, a prominent citizen of the place, and A. F. Williams, who had been well and favorably known in connection with water ditches in northern California, made a proposal to furnish Marysville with gas and water. Proposals were also made by Tiffany and Wethered

of San Francisco, and by Dr. Teegarden of Marysville and David E. Knight, who was then connected with the gas works in Sacramento.

May 22, 1858, the Marysville Goal Gas Company was incorporated by David Edgar Knight, Charles H. Simpkins and Adoniram Pierce, with a capital stock of $50,000. This was subsequently increased to $100,000. May 10, 1858, the right to lay pipes through the streets of Marysville for the purpose of distributing gas was granted to D. E. Knight & Co. In exchange for the privilege the company agreed to furnish free gas for lighting public buildings so long as no franchise was granted to any other gas company. Thus was the original company safe-guarded against competition. The work of constructing the gas plants was personally supervised by Knight, Simpkins, and Pierce.

Gas was first manufactured in Marysville August 18, 1858, and sold for $12.50 a thousand cubic feet. The works consisted of two benches of 3's, iron retorts in what was known as the H setting. The retort house

Original 20,000-Foot Gas Holder, With Glimpse of Knight Residence.

was a small, brick, flat-roofed warehouse, and the capacity of the works was 18,000 cubic feet in twenty-four hours. The flat roof of the retort house was found convenient as a scaffold while cleaning out stopped stand pipes through holes in the roof. The condenser consisted of a 3-inch, cast-iron, return pipe located in the coal shed. Two wooden casks, one above the other, served the purpose of the washer and scrubber. The purifiers were made of wood, and hydrate of lime was used on perforated, sheet-iron trays. A 3-foot station motor completed the sequence of apparatus up to a 20,000-cubic-foot gas holder.

In 1860 the distributing system consisted of 14,550 feet of mains, from which were served 200 consumers. The average output of gas was 200,000 cubic feet a month. The first reduction in price was made December 16, 1860, in response to a public petition. A system of discounts was established, 10 per cent being allowed on consumption of more than 200 and less than 1000 cubic feet a week, and 15 per cent discount on all gas consumed amounting to more than 1000 cubic feet a week.

In 1862 a uniform price was established of $10.50 a thousand. In the spring of 1867 the works was reconstructed on the original location.

The iron work, including the gas holder for reconstructing the gas works, was shipped from Philadelphia on the clipper ship "Old Hickory" some time during 1866. The ship was 356 days on the voyage, and was given up by the underwriters as lost. The owners did not lose their ship, but the captain lost his commission as her master.

During 1867 a voluntary reduction to $9 a thousand was made in the price of gas. From the beginning of this industry in Marysville gas was made entirely from Cannel coal from Scotland, Ireland, New Brunswick and Australia, sacked in gunny sacks in San Francisco and reshipped by river steamer to Marysville. Old timers in the gas business will remember the names of Boghead, Ince Hall, Lesmahoga, and Albertite, as well as Australian shale. The price of this coal ranged from $25 to $50 a ton. Excessive freights did not warrant the use of low-grade coal in the interior towns of California, as the rate from San Francisco to Marysville, together with drayage, was in excess of the rate by ship round Cape Horn. Castor beans, rosin, wool waste, and pitch pine were also used from time to time to assist in making gas. Lime was hauled in half-barrel rawhide baskets from Cave City, and delivered in Marysville at $2 a basket.

The fire brick used in the construction of the benches were shipped from the east, packed in straw in crates, and cost $125 a thousand. But there were some consoling features in the business, as coke sold for one cent a pound (unscreened) and tar brought $7.50 a barrel, the purchaser furnishing the barrel.

There was no competition until 1886, when an electric light plant was established. But it was not until late in 1898 that a rival gas company came into the field, with a water-gas plant having a capacity of 3000 cubic feet an hour. March 1, 1899, after competition lasting just four months, the two gas companies became merged under the new title of the Marysville Gas and Electric Company. The consolidation of the companies marked the beginning of a new era in selling gas in Marysville.

A further reduction in rates and persistent missionary work resulted in placing Marysville in the front rank as a gas-consuming town. In 1896 there were only six places in Marysville using gas for fuel. In less than six years more than 300 gas stoves were installed in Marysville homes. Today gas is generally used there as a kitchen fuel and for heating.

The water gas sets installed in 1898 were displaced September 1, 1901, by a Lowe, crude-oil, water-gas set, having a capacity of 90,000 cubic feet every twenty-four hours.

Since the consolidation of the rival gas companies, eleven years ago, all the gas used in Marysville has been made at the works near the levee, adjoining the electric substation of the Pacific Gas and Electric Company. At this works there is a 20,000-cubic-foot storage holder, installed in 1898, and a 20,000-cubic-foot relief holder. There has also been recently installed a 175,000-cubic-foot, crude-oil gas set. Pipes to the original gas works connect with and make use of the old 20,000-cubic-foot holder that came "round the horn."

Nearly every new enterprise is stamped at the beginning with the personality of some one man. Marysville's gas business was the creation of David

E. Knight. He was a remarkable man in his town. He had been a plumber, a copper-worker, a cobbler. Then began his time of bigger undertakings. He established the first horse-car line between Marysville and Yuba City, and was president of the company; he owned the race track; he started the first steam laundry, situated where the old Columbia Hotel now stands; he was one of the three owners of the Marysville Foundry; he was president and manager of the Marysville Woolen Mills; and was president and manager of the Marysville Gas and Electric Company. The Sacramento river boats "Knight No. 1" and "Knight No. 2" were named after him. When he died, January 5, 1900, the board of supervisors, of which he was a member, published in memoriam an expression declaring: "He was a pioneer citizen of our state, and one of that sturdy type of men who have builded so truly, so permanently, and so splendidly the social and industrial structure of California statehood. As a citizen he was enterprising, progressive, and judicious. His life was full of substantial accomplishments marked by uniform justice during its course and by a beautiful charity at its close. As a member of this board he was constant in his attention to duty, liberal in his policy, and wise and just in his counsel. His loss to us can not well be replaced, and we deem it a privilege to make here this acknowledgement of his worth and to pay this tribute to his memory.

Such was the man who established the Marysville gas business now owned by the Pacific Gas and Electric Company.

There is a little old one-story brick building at the corner of Second and B streets in Marysville. That was the original gas works. The front end of it is now used as the Marysville office of the Pacific Gas and Electric Company. At the corner of the curb on two sides of the street, half buried in the earth, are two of the original cast-iron retorts used in the first manufacture of gas in Marysville. They serve now to protect the sidewalk from the encroachment of wheels of passing vehicles. Just back of this old building, looming big and red amid shade trees and huge old fig trees, is the former home of David E. Knight.

The writer in preparing this article has drawn freely from an excellent historical sketch entitled "Auld Lang Syne" by T. R. Parker of Napa, who was an associate and warm friend of David E. Knight, and was superintendent of the Marysville Gas Works from 1862 to 1867.

PUBLIC CONTROL OF POWER SECURITIES AND RATES.[1]

BY F. P. ROYCE.

The position taken by some of the state commissions on the questions of public policy involved in the determination of fair rates and issue of securities is of interest. In Massachusetts the Board of Gas and Electric Light Commissioners appointed in 1885 were at that time given the right to supervise rates, and in 1894 were given the power to control issues of stock and bonds. They have from the first taken the position that no company should have outstanding permanent securities representing more than the fair structural valuation of the property without allowance for working capital or for the value of the "going business," except that in connection with the organization of a few new companies they have made a small allowance for working capital. The result has been that in numerous instances they have refused to authorize issues of securities in whole or in part because the companies in question have suffered some impairment of their assets, due either to depreciation which had not been provided for by the company, or perhaps to changes in the art which have made it necessary to buy new equipment in the place of old. In such instances the companies in question have been obliged to make up the deficit due to impairment of assets out of their earnings before new securities can be issued for further requirements.

On the other hand the commissions in New York and Wisconsin have not thought it necessary to inquire into the capitalization of the companies outstanding at the time of the appointment of the commission and have only considered the question as to whether or not the proposed extensions of capital were necessary for the requirements of the business. Under the Massachusetts law, as stated, the Board of Gas and Electric Light Commissioners and the Board of Railroad Commissioners have the right to determine the price at which additional stock may be issued. Until within a year or two, the price so fixed was the fair value of the stock "taking into consideration the market value and other pertinent conditions." The laws have now been changed so that stock may be issued at a price to be determined by the directors, provided the commission decide that it is not too low to be compatible with the public interests. These laws were intended to prevent stock watering or to prevent a stockholder gaining a material advantage in case the stock of his company was selling at a substantial premium by being able to buy additional stock at par. It may be questioned, however, if the operation of the law has worked to the best interests either of the stockholder or the public. The result has been that for most companies there has been in fact a steadily increasing par value of the stock as determined by the commissioners, and if, for instance, a new issue has been authorized at $180 or $200 per share, the effect has been to place that par value on all stock previously issued. The law of the state in providing that new issues of stock should be sold at approximately their market value, has prevented stockholders from getting a large profit by the purchase of new stock at par which would at the time command a higher price on the market; but, on the other hand, whenever new stock has been authorized at a price higher than that of previous issues the effect has been to virtually ratify the market price on all the old stock at the time outstanding. This has actually created a greater inflation than would have been caused by granting authority to issue new stock at par.

Undoubtedly these conditions will be more clearly understood as time goes on and the commissions will be able to formulate definite policies, which on the one hand will assure the customer fair prices with good service and on the other will treat the companies with proper liberality so that the capital without which they cannot be developed wil lbe furnihsed by conservative investors.

[1]Extract from an address before the Graduate School of Harvard University on May 16, 1910.

CALIFORNIA FUEL OIL.

Gas Analysis

(Continued.)

BY R. F. CHEVALIER.

Reagents.

The reagents used are as follows:

For carbon dioxide (CO_2), potassium hydrate solution (caustic potash); for oxygen (O), potassium pyrogallate solution or phosphorus; for carbon monoxide (CO), cuprous chloride solution.

Potassium Hydrate (caustic potash).—500 grams of the commercial hydrate (caustic potash) is dissolved in one litre of water; or, one part by weight of caustic potash is dissolved in two parts by weight of water. Absorption capacity, 1 cc absorbs 40 cc of CO_2.

Potassium Pyrogallate.—Dissolve five grams of solid pyrogallic acid in 100 cc of potassium hydrate solution made by dissolving 120 grams of caustic potash in 100 cc of water. Caustic potash purified with alcohol should not be used or erroneous results will be obtained. Absorption capacity, 1 cc absorbs 2 cc of oyygen.

Phosphorus is a convenient absorbent for oxygen. It should be handled very carefully, as it is highly inflammable. It is used in the solid form in sticks about ¼ inch in diameter and three or four inches long. It must be kept and handled under water. There are occasions when the Orsat apparatus is used in places where the temperature is high; in this case, phosphorous should not be used, as it melts at a low temperature (112° F.) and will form in a solid lump at the bottom of the pipette, choking the connecting U tube. For the absorption of oxygen, the gas is passed into the pipette containing the phosphorous and kept in contact with it from three to five minutes. Phosphorous will remain serviceable for a long period.

Cuprous Chloride.—Is best prepared by covering the bottom of a half-gallon bottle with a layer of copper oxide ½ inch deep, placing in the bottle a number of copper wires reaching from top to bottom, and filling the bottle with common hydrochloric acid of 1.10 sp. gr. The bottle is occasionally shaken and when the solution is nearly colorless, it is ready for use. Absorption capacity, 1 cc absorbs 1 cc of CO.

Sampling.

The taking of the sample of gas to be analyzed is of great importance. The location of the sampling nipple should be given careful consideration, as the gases at various points are often of varying composition. If a boiler setting were perfectly tight and no infiltration of air took place, the best results would be obtained by placing the nipple in the stack or flue at its smallest cross section. Usually by the time the gases reach this point they have been thoroughly mixed and an average sample can be obtained at any point. Owing to the possible leakage of air through a setting, it is best to take the sample near the furnace slightly beyond the point where the visible flame ends.

In return tubular, or water tube boilers with horizontal baffles, the same nipple should be inserted at the rear of the furnace, just before the gases enter the tubes, or the first pass. In the case of water tube boilers with vertical baffles, such as the Babcock & Wilcox, the sample tube should enter the setting at or near the top of the first pass near the baffles. Means should also be provided for inserting the sampling tube near the front header.

Whenever possible the sampling tube should enter through the side wall of the boiler setting, thereby enabling the collection of samples at different points across the furnace or pass.

By starting with the sampling tube at a point six inches in the pass taking a sample, then extending the tube one foot into the pass and taking another sample, and so on, until samples have been collected from the various points across the width of the pass or furnace, thereby averaging these, a correct composition of the gas is obtained.

Sampling Tubes.

Various types and arrangements of sampling tubes have been suggested and tried for securing at once an average sample, but it is hardly probable that a tube with various branches, a long slit or a number of small holes, will give a fair sample, since the velocity of the gases in the aspirating tube is such that most of the gas will be collected at the openings nearest the apparatus.

Tubing of Bohemian, combustion or Gena glass, or porcelain, should be used. For temperatures up to 1200° F. the glass tubing is preferable. The porcelain tube is used when the temperature of the gases is above 1200° F. or when gases are taken from the furnace. The latter tubing is expensive and brittle, therefore glass tubing should be used whenever possible. Metal tubes such as iron or brass pipe should never be used unless cooled, as the composition of the gaseous mixture is liable to change by their use, resulting in an increase of carbon dioxide. The shorter the rubber tubing connecting the sampling tube with the Orsat apparatus the better, as rubber has a tendency to absorb gas.

(To be continued.)

CONDENSERS FOR SMALL CENTRAL STATIONS.[1]

BY HARRY REMINGTON.

It is the purpose of this paper to set forth the effect of vacuum on the steam consumption of various types of prime movers and to discuss briefly the elementary facts of condensation.

The maximum efficiency possible for any heat engine is determined by dividing the difference between the absolute temperature at which the working fluid is received and the temperature of rejection by the temperature at which the fluid is received, from which it is evident that any lowering of the temperature of rejection greatly increases the efficiency of the heat motor. The curves of a diagram arranged to illustrate this, show graphically the theoretical increase in efficiency due to reducing the exhaust temperature and pressure.

It is seen that the higher vacuum employed, the greater is the increase of an ideal engine, for each inch in vacuum. Thus, while at 20-in. vacuum an in-

[1]Extract from paper read at Sixth Annual Convention Southwestern Electrical and Gas Association, Beaumont, Texas, May 14, 1910.

crease of vacuum to 21 in. adds only 3 per cent efficiency, the increase in efficiency resulting in increasing the vacuum from 28 to 29 in. is as much as 15 per cent. A glance at a steam table will at once explain this, for, while the drop in temperature of saturated steam from 20 to 21 in. vacuum is only 5 degrees F., the drop from 28 to 29 in. is 22 degrees F.; from another point of view, the pressure multiplied by the increase in volume of a pound of steam from 20 to 21 in. is 286 foot-pounds, while from 28 to 29 inches, it is 1137 foot-pounds. In the above and throughout this paper, unless otherwise stated, reference is made to a 30-inch barometer, that is, a 28-in. vacuum means an absolute vapor pressure of 2 in.

Certain types of prime movers are capable of utilizing low back pressure more than others. We can divide all heat engines working with steam into reciprocating engines and steam turbines. Reciprocating engines can in turn be divided according to the speed, the number and type of valves, and the number of cylinders. The economy to be derived from running condensing any of these various engines will in general depend on the steam saving in each case, the value of steam and the cost of vacuum.

The simple slide valve engine, subject to great losses due to wire drawing in the valve, large clearance spaces and considerable cylinder condensation, usually consumes from 30 to 50 pounds steam per brake horsepower when running non-condensing, depending upon the type of governor and the load. Even this engine, ill adapted as it is to derive benefits from reduced back pressure, shows considerable improvement.

The single expansion, slow speed, four-valve engine is more efficient and the table below shows how the economy of this type of engine is affected by the condenser. Roughly speaking, the steam consumption is reduced 25 per cent.

TABLE 1.—STEAM CONSUMPTION OF SINGLE CYLINDER FOUR-VALVE ENGINES.

Type	Non-Condensing	I.H.P.	Lbs. St. I.H.P. Hr.
Corliss, Jacketed	Peabody, Thermodynamics	237.0	21.5
Fleming	Prof. Carpenter, June 28, 1905, Cornell University	217.9	22.46
Fleming	Prof. Spangler, June 6, 1905, Univ. of Penn	132.0	22.24
Corliss	Peabody Thermodynamics	120.0	23.9
Corliss	Barrus, Engine Tests, P. 47	506.0	25.8
Corliss	Barrus, Engine Tests, P. 126	342.0	25.9
	Condensing.		
Corliss, Jacketed	Peabody Thermodynamics	155.0	16.5
Poppet Valves, Jacketed	Zeit, D. V. D. Ing. Aug., 1905, P. 1310	262.0	15.0
Gridiron Valves	Barrus, Engine Tests, P. 101	613.0	18.5
Corliss	Barrus, Engine Tests, P. 118	554.0	19.45
Slide Valve	Barrus, Engine Tests, P. 88	213.0	22.0
Corliss	Peabody, Thermodynamics	145.0	19.4

(Gebhardt's "Steam Power Plant Engineering.")

The compound engine with Corliss valves is of more general importance. The economy of using condensers with this type of engine is much greater than with simple engines. This arises from the fact that the exhaust valves open more widely, that there is a less range of temperature and hence less condensation in each cylinder, and, also because the ratio of expansion can be made greater. The results of a number of tests of compound engines, as reported in the various technical papers and proceedings are given in the following tables. The steam per horsepower hour decreases with the increasing size of the engine. Likewise, the economy derived from condensing apparatus increases as the engine size increases.

TABLE 2.—STEAM CONSUMPTION OF COMPOUND ENGINES.

Type	References	I.H.P.	Lbs. St. I.H.P. Hr.
	Non-condensing		
Williams	Peabody, Thermodynamics	39.6	19.2
Williams	Peabody, Thermodynamics	33.0	21.4
Ball, Chicago Public Library	Eng. Record, Aug. 6, 1908	187.5	21.14
Westinghouse Marine	Power, Aug., 1903	540.	19.3
Skinner, Cross Comp.	Power, July, 1906	375.	21.14
Buffalo, Tand. Comp.	Elec. World, May 23, 1903	121.	22.3
Reeves, Vert. Cross-Comp.	Eng. Record, July 1, 1905	185.0	20.0
Cross Comp., 4 - slide valves	Barrus, Engine Tests, Page 181	486.7	21.59
4-Cylinder Comp. Locomotive, No. 2512, Penn. System	Tests made at Louisiana Exp., 1904	495.0	18.6
	Condensing.		
Cross Comp. Corliss, Atlantic Mills Prov.	Amn. Elec. June, 1903	500.0	11.20
Leavitt Pumping Engine, Louisville, Ky.	Trans. A. S. M. E., Vol. 16, P. 169	648.0	12.20
Rice & Sargent Corliss, Amn. Sugar Refinery, Brooklyn	Trans. A. S. M. E., Vol. 24, P. 1274	627.0	12.10
Fleming Four Valve	Trans. A. S. M. E., Vol. 25, P. 212	348.0	12.13
Williams Vertical, N. Y. Navy Yard	Power, Oct. 1903, P. 583	340.0	12.60

(Gebhardt's "Steam Power Plant Engineering.")

Turning now to the steam turbine, we find that this type of heat motor, owing to the greater ratio of expansion and the fact that there is no alternate heating and cooling of metal surfaces to cause condensation within the turbine, derives the greatest benefit from condensing apparatus. In the turbine, the steam is allowed to expand completely to condenser pressure while doing work. The increase in economy of a 300 kilowatt Parsons turbine with increase in economy amounts to 40 per cent, corresponding to a reduction in steam consumption from 34.1 pounds to 21 pounds per kilowatt hour.

The lessened steam consumption due to operating under reduced back pressure is not the only important advantage to be derived from running condensing. Besides the saving in steam, which represents a coal saving, there is the increase in the capacity of the plant to be considered. With the same boiler equipment, we see that we can obtain more power per pound of steam when running condensing than when running non-condensing. Let us assume for instance, that a given equipment of boilers, engines, buildings, etc., cost $100.00 per horsepower, and that the size of the plant is 500 horsepower. By installing a condenser, the capacity of the plant could be readily increased to 625 horsepower, reducing the cost per horsepower, excluding for the present, the cost of the condenser, to $\frac{500 \times 100}{625}$ equals $80.00. Thus, there would be warranted an expenditure of about $20.00 per horsepower for condensers. This is many times the cost of a highly efficient surface condenser.

Principles of Condensation.

The condensation of steam can, for our present purpose, be considered as a very simple process. A pound of steam at a pressure of 1½ in. absolute, corresponding practically to 3 in. of mercury or 27 in. vacuum, referred to a 30-in. barometer, will occupy, as may be found in the steam tables, a volume of 231.8 cu. ft., and will have a temperature of 115 degrees F. If the steam is saturated, that is, in contact with water, the temperature will remain the same so long as the pressure remains unchanged.

If this steam pressure is maintained within a condenser that is receiving steam constantly from an engine or turbine, a volume and weight of steam must be condensed during each minute equal to the rate of inflow, otherwise the pressure and temperature of the steam within the condenser will be raised by compression. Now to condense one pound of steam at the pressure and temperature given requires the abstraction of 1027 b. t. u., the latent heat of the steam under these conditions.

As a pound of water will absorb one thermal unit when its temperature is raised 1 degree F., 51.4 pounds of water raised through a range of 20 degrees F. of temperature will therefore be required for each pound of steam condensed. Similarly 34.2 pounds raised 30 degrees F.; 25.7 pounds raised 40 degrees F., or 20.5 pounds raised 50 degrees F. may be used to perform the same duty. The temperature at which cooling or circulating water is received is usually fixed by the conditions and surroundings of the power plant. The temperature to which the water can be raised is limited by the temperature of the steam, and a perfect condenser would heat the circulating water to this temperature, and would require the theoretically minimum amount. Practically, however, there must be some difference in temperature between the steam and the water in order that the heat may flow from the steam to the water, as through the metal tubes of a surface condenser. In a jet condenser, where the steams comes into immediate actual contact with the water, conditions are different, and if through intermixture is secured the temperature of the water may be brought very close indeed to that of the steam.

Under the simple conditions above assumed, and assuming a perfect condenser, the vacuum is determined and solely by the temperature and amount of cooling water available. That is, if the amount of cooling water is so limited that it must be heated to 120 degrees F. in order to absorb all the heat of the steam, the best possible vacuum would be 26.56 in. If there is sufficient cooling water to absorb all the heat with a rise of temperature to 110 degrees F. the best obtainable vacuum would be 27.41 in., similarly for 100 degrees 28.07 in., and for 90 degrees, 28.58 in., for 80 degrees, 28.97 in., for 70 degrees, 29.26 in., and for 60 degrees, 29.48 in. A condenser based on these facts would consist then only of means of circulating the cooling water, of bringing the steam and water together and of removing the water resulting from the condensation of the steam.

In practice, however, the problem is much complicated by the entrance of another element, namely air, and it is the influence of air in the condenser that proves a stumbling block to many who attempt to understand the workings of a condenser.

The important fact to be kept in mind is Dalton's law of mixed vapors, which may be stated in this wise: "A constant weight of gas maintained at a constant temperature confined in a vessel of constant volume exerts the same pressure upon the walls of that vessel regardless and independently of any other gas or vapor present or introduced into the vessel."

Air and water vapor in a condenser obey this law of mixed gases. That is, if the temperature of the condenser is 101.5 degrees F., the pressure due to the water vapor in that condenser is exactly one pound per square inch. The total pressure in the condenser may be something quite different, as 1½ pounds per square inch, in which case the additional ½ pound must be due to the presence of some other vapor or gas, such as air.

The amount of air present is easily calculated from Boyle's and Mariotte's laws, namely, that at constant temperature the pressure of the gas varied inversely as its volume and that at constant volume the pressure varies directly as the temperature measured from the absolute zero, namely, 463 degrees F.. Combining the two laws we have the formula: $PV = RT$, in which if P is pounds per square inch, V cubic feet per pound of gas and T absolute degrees temperature, F. and the constant R 37.

With this explanation, let us return to the consideration of what goes on in the condenser. At the inlet opening we have a constant inflow of practically pure water vapor with only a very small, almost negligible percentage of air. This vapor, upon striking the cold circulating water rapidly condenses, becoming richer in air until, at the extreme part of the condenser we have a mixture of which air constitutes an important part.

How much water vapor and how much air there will be in a cubic foot of the mixture at this farthest point, which should be the location of the air pump suction, we can determine if we know the total pressure in the condenser and the temperature at the air pump suction. The pressure is practically uniform throughout the condenser. Let us suppose that it is 1½ pounds per square inch, as assumed above, then the temperature at the inlet where there is practically pure water vapor will be 115 degrees F. Assume that the temperature of the mixture at the air pump suction is 60 degrees F. From the steam table we readily determine the weight of a cubic foot of steam at 60 degrees F. .000828 pounds, and the pressure corresponding to 60 degrees F., or ¼ pound. Subtracting this from 1½ pounds, the total pressure, the best obtainable vocuum would be 27.07 in., and for we get the partial pressure of the air, and knowing its temperature and volume we obtain its weight. As a cubic foot of air at 60 degrees F. and 14.7 pounds per square inch pressure weighs .076 pound, we can calculate by means of the above formula, that each cubic foot of the mixture will then contain .00645 pound of air, and it will be seen that the air pump capacity required is determined solely by the number of pounds

of air entering the condenser per minute, and the temperature and pressure at which the mixture is withdrawn. As will be seen, a high vacuum is impossible without a cold air pump suction and a hot air pump necessarily implies a low vacuum.

ECONOMY IN LARGE TURBINE ELECTRIC PLANTS.

"The centering of power generation into a single generating plant for any large establishment is accomplished by economies in power generation," says Professor Dugald C. Jackson, the newly elected president of the American Institute of Electrical Engineers, "that are of themselves appreciable, besides contributing to reliability."

"Without the electrical distribution of the power," continues Professor Jackson, "such concentration could not be adequately carried out at all. Moreover, whatever limitations still exist toward improving the economy by completely concentrating the power generation in any industrial establishment, exist with respect to the prime movers and not with respect to the electrical distribution of the power. Where hydraulic prime movers are to be considered, the concentration may ordinarily be made as complete as the conditions of the water supply will permit, since the charges on account of first cost of installation and the labor cost of operating practically dominate the cost of the power developed, and these may ordinarily be expected to decrease per unit of output as the capacity of the plant is increased, under conditions of equal or improved load-factor. An equivalent condition has not heretofore existed where steam prime movers have been used. Since neither labor cost nor steam economy are much improved by increasing a steam-electric generating plant over a size of a few thousand kilowatts capacity when reciprocating engines are used, the need of extreme concentration of individual plants has not heretofore been acutely felt.

"But the advent of large steam turbines has altered the conditions. Plants equipped with these machines installed in association with boilers provided with adequate labor-saving appliances may be operated with labor costs that vie with the labor costs pertaining to hydraulic generating plants equipped with machines of equal size; and the steam economies derived from the newer steam turbines are remarkably satisfactory. The operating economies of large steam-turbine plants, either in respect to the use of labor or the use of fuel, do not however seem to be exhausted within the limits of capacity yet attained in even the largest generating plants now in commission. Moreover, the first cost per kilowatt of capacity of plant, including land, buildings, and machinery, falls off in an important degree for the larger steam turbine plants, until such a plant may nearly rival a hydroelectric plant in the gross cost per kilowatt-hour of energy delivered at the switchboard, through the fact that the fuel cost pertaining to the steam-turbine plant has an offset in the charges caused by larger first cost per kilowatt of capacity of hydraulic plant."

THE PLACE OF STEAM TURBINES.

Concerning the choice between steam turbines or piston engines for power in mill plants, Mr. F. W. Dean, of Boston, says in a recent paper.:

There is no doubt that where electricity is to be used the turbine should be chosen. It is fully equal, if not superior, in economy to the piston engine. It requires less room, less foundation, less oil, the wear is almost nothing, and the fact that oil is not used in the steam renders it practicable to use condensed steam for feed water. This is of great advantage in bad water districts, and means freedom from boiler difficulties, and the absence of water purification devices.

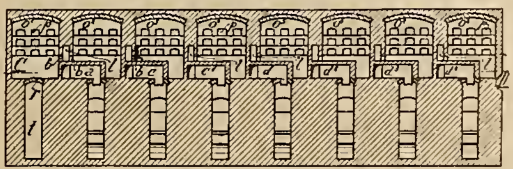
The turbine does not lend itself to belt driving, and in cases where electricity is not desirable the piston engine will hold its place. Such cases are mills where nearly all of the machinery operates simultaneously, as in textile mills, and in which there is an opportunity for simple direct drives by belts or ropes. In this case the cost of installation and of fuel is less than by any other combination. Where there are tools or machines that operate intermittently the electric system is advisable, and, in my opinion, direct current is to be preferred to alternating on account of the absence of power factor troubles. In many cases, however, it is not practicable to use direct current on account of the length of transmission. In some machine shops I have known the power factor to be as low as 60 per cent, which means that the generator will give only 60 per cent of the power that it would give if the power factor was 100 per cent, which it would be if it was carrying a lighting or an electrolytic load. The other 40 per cent takes the form of a wattless current which has no capacity to do work, and which vibrates back and forth between the generator and motors, having no effect except to heat the generator, wires and motors. The wattless current, I understand, does not consume or waste power, except the equivalent of the heat generated. In chocolate factories the power factor I have found to be about 70 per cent. In any factory where the load is intermittent the power factor will be low.

In regard to the reliability of turbines I know of a 500 k.w. turbine that has run 24 hours per day without stopping for 11 months. It was stopped for general examination and showed no sign of wear, nine cents were spent for repairs, and it was then started again. It then ran 14 months 24 hours per day without stopping and is now stopped for connection with a new switchboard. It will be examined, but the only known defect is slight leakage of a valve. Another turbine in the same house has made one run of three or four months and one of one month, both without stopping. It has not been used as much as the other because the other kept going.

In very large central power stations nothing but turbines should be given the slightest consideration for they are the cause of the wonderfully low cost of power for the reasons above stated, which appear in such cases in maximum form.

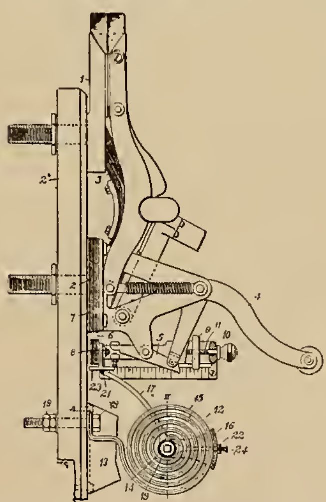
PATENTS

964,341. Method of utilizing Spent Fire-gases from a Furnace for Firing Further Furnaces. Hermann Uihlein, Nuremberg, Germany. The method of utilizing spent fire gases from a furnace for firing further furnaces, which consists in passing the spent fire gases from any furnace over glowing carbon of any kind at disposal charged into generators beneath following furnaces, so as to reduce their carbonic acid to carbonic oxid and to oxidize small quantities of the glowing car-



bon to carbonic oxid, in burning the regenerated gases with air for heating the respective furnaces, and repeating the process with the spent fire gases, so formed in the then following furnaces until the spent fire gases from the last furnaces are allowed to escape through a chimney, care being taken that the temperature of the glowing carbon does not sink beneath a determined limit, at which moment it is replaced b ya fresh charge of glowing carbon.

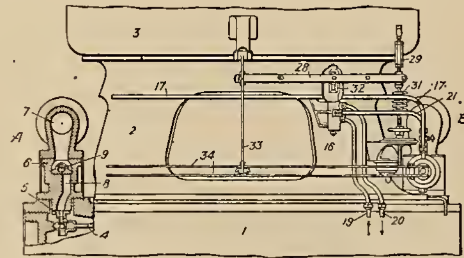
963,764. Electric-Circuit Interrupter. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. In a circuit interrnpter, the combination with stationary and movable contact members, a latch for holding the members normally in engagement, and a tripping magnet for the latch having a movable core member, of



two double-strip current-conducting spirals having rigidly mounted outer ends and rigidly connected but jointly movable inner ends, a device for supporting the movable core member in its no-load position, and means for adjustably connecting said device to the inner ends of the spirals.

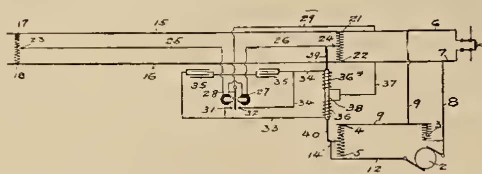
964,474. Manufacture of Incandescent Electric Lamps. Dennis Joseph O'Brien, San Francisco, Cal., assignor, by mesne assignments, to William P. Fairman, Philadelphia, Pa. The herein described process for the manufacture of electric tube-lamps which includes the following operations, viz: preparing the tube for the exhaust-pnmp; glanding the tube outwardly and laterally; inserting the filament in the open-ended tube and anchoring the ends of the filament to the glands; capping the glands and fitting both their caps and the outer ends of the anchors for connection in an electric circuit; pumping the air out of the tube and sealing the tube.

963,811. Governing Mechanism for Elastic-Fluid Turbines. Frederick Samuelson, Rugby, England, assignor to General Electric Company. An elastic fluid turbine mechanism for controlling the admission of motive fluid to the turbine wheel comprising a cylinder, means supplying lnbricant under pressure to the turbine, a piston operating in said cylinder and



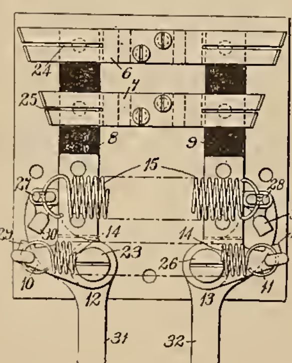
acted upon on one side by the pressure of the motive fluid supplied to the turbine and on the other side by fluid under pressure from said means, a pilot valve operated by the turbine governor for controlling the admission of fluid from said means to the cylinder and its exhaust therefrom, and a follow-up device for the pilot valve.

963,867. Electric-Control System. William M. Chubb, San Francisco, Cal. In an electric control system, a divided circuit, a resistance in each circuit, points of equal potential on the resistances, contacts on said points, a conductor connecting the contacts and electro-magnetic means in the con-



ductor operated by the movement of one contact to a point of different potential to cause a solenoid to be energized, an iron core in the solenoid connected with the other contact point and adapted to be moved by the solenoid to cause the contact point to move to a point of like potential.

963,735. Electric Switching Device. Christian Aalborg, Wilkinsburg, Pa., assignor, by mesne assignments, to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. In a switching device, the combination with a plurality of



sets of stationary contact terminals disposed in pairs in adjacent planes; of two spring-connected but independently movable contact-bearing switch arms adapted to electrically connect and disconnect said pairs of stationary contact terminals, and means for effecting a quick separation of each switch arm from the corresponding stationary contact terminals.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.
DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong
604 Mission Street, San Francisco

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Electrical Precipitation of Smoke

The smoke troubles of the power plant are small as compared with those of the smelter. Every week we read of some smelter that has been closed down because of alleged damage to surrounding vegetation from the sulphur dioxide resulting from the treatment of sulphide ores. Many attempts have been made to remove the sulphur from the smelter fumes, filtration through woolen bags being one of the most successful, especially at the plants around Salt Lake City.

A new process of electrical precipitation, devised by Dr. E. G. Cottrell of the University of California, was described by him at the San Francisco meeting of the American Chemical Society last week, the precipitation of suspended matter being accomplished by the discharge of a high voltage direct current. This phenomena is closely allied to the disruptive conduction of the Geissler tube which is used in the Moore light. Under the influence of this current the charged gas particles migrate to a lead plate where they are precipitated and finally recovered as dilute sulphuric acid. An alternating current is stepped up through a transformer to 40,000 volts and rectified by means of a synchronous motor, so adjusted that only the peak of the wave is utilized. The discontinuous direct current thus produced is discharged from an asbestos electrode suspended in the midst of the smoke, thereby removing the obnoxious gases.

In 1851 it was found that smoke could be cleared by a static electric discharge from a Leyden jar. In 1882, Sir Oliver Lodge gave a lecture on the electrical precipitation of fumes, his method being later patented for use with a Wimhurst machine. It lay dormant for over twenty years, until Dr. Cottrell, while investigating its application to the contact sulphuric acid process, realized its tremendous value to the smelters, which were then beginning to be shut down as public nuisances. His investigation showed that while an alternating current slowly agglomeratized the suspended matter, the best results were obtained with a high voltage direct current, giving a brush discharge. A roughened electrode, such as asbestos or micanite, from which the binding material has been removed, gives the best results, as there is a tendency towards an uneven point discharge.

The first commercial plant was installed at the Selby Smelter on San Francisco Bay. Another plant is now being put in to treat the fumes at the Balalakala smelter in Shasta County, California, which has been allowed to continue operations pending the completion of the electrostatic apparatus in October of this year.

As shown by Dr. Cottrell, the bag process, while well adapted to the treatment of blast furnace gases having a low content of sulphuric dioxide, is not so successful in treating the roaster and refinery fumes which are so strong as to soon destroy the woolen bags. The cost of the reinforced concrete bag houses is high and the electric power consumption for the blower is as great as that required by the electrostatic process.

PERSONALS.

C. L. Cory, electrical engineer, has been in Southern California.

A. M. Hunt has returned to San Francisco from the Santa Cruz Mountains.

Gifford Pinchot is making speeches in California in behalf of local "insurgent" politicians.

W. H. P. Hill, manager of the Monterey County Gas & Electric Company, is at San Francisco.

H. R. Noack, of Pierson, Roeding & Co., has returned to San Francisco from a visit to Quincy, Cal.

B. W. Collins, formerly sales manager of Parrott & Co.'s northwestern office, has been appointed city electrician at Tacoma, Wash.

J. A. Cranston, of Portland, who is interested in the Washington Water Power Company, of Spokane, arrived at San Francisco last week.

H. F. Way has been made general manager of the gas, water and electric interests of the Yakima-Pasco Water Power Company at North Yakima, Wash.

L. R. Pomeroy has been appointed chief engineer of the railway and industrial division of J. G. White & Company, incorporated, with headquarters in New York City.

E. C. Bradley, vice-president and general manager of the Pacific Telephone & Telegraph Company, with headquarters at San Francisco, returned from New York last Sunday.

J. H. Leary has become assistant manager of the Central California Traction Company, of Stockton. He was formerly a Southern Pacific chief train dispatcher under Division Superintendent J. D. Brennan.

Louis McKissick, assistant general superintendent of the Western division of the Western Union Telegraph Company, and formerly wire chief in the San Francisco office, has been appointed general superintendent of the company's newly created "Gulf" division.

J. C. Murray, sales engineer with the Kellogg Switchboard & Supply Company has left on a six months business extension trip in South America, stopping at Bahai, Rio de Janeiro, Sao, Paulo, Montevideo, Buenos Ayres, Santiago, Lima, Colon and other cities.

O. F. Metz has joined the staff of W. S. Heger, Pacific Coast manager of the Allis-Chalmers Company, as office engineer, with headquarters at San Francisco. He has been connected with the Northern division of the Pacific Gas & Electric Company recently, but was for some years formerly with the Allis-Chalmers Company.

L. W. Storrer, who was for many years Pacific Coast manager of the Postal Telegraph Company, and had been acting in an advisory character during the past year, severed his connection with the corporation this month, taking charge of the telegraph department of the Pacific Telephone & Telegraph Company, with headquarters in San Francisco.

Ely C. Hutchinson has returned to the Pelton Water Wheel Company's San Francisco office after visiting the Northwest where he secured a contract for a large Pelton-Francis turbine water wheel to be installed at a hydroelectric plant in Idaho. The electric equipment including that of the power house and apparatus for two sub-stations was awarded to the General Electric Company.

C. E. Sloan, of the engineering firm of Spalding, Sloan & Robson, returned to San Francisco last week after completing a seven-mile sewer system at Newman, Cal. The same firm also had charge of the construction of a novel waterworks plant, which has been in operation a short time. The triplex pump can be operated either by gasoline or electric power and steam power can be utilized in emergency.

FUEL INVESTIGATIONS BY BUREAU OF MINES.

The act establishing a Bureau of Mines in the Department of the Interior, approved May 16, 1910, became effective July 1. As originally approved, the law contemplated the transfer of the entire Technoligic Branch of the United States Geological Survey, the mine accident investigations, fuel investigations, structural materials investigations, the entire personnel, property and equipment, to the Bureau of Mines, but the Sundry Civil appropriation act approved June 25, amended the law to such an extent that the structural materials investigations, including the personnel and equipment for these investigations went to the Bureau of Standards, Department of Commerce and Labor.

The fuel investigations under the Geological Survey and which are transferred to the Bureau of Mines have already resulted in a better realization throughout the country as to the value of fuels. One result of this work is that nearly all of the fuel now purchased by the federal government is bought on specifications and subject to test by the Fuel division, or purchased after examination made of the coal supplied by the mines from which coal is delivered to the government.

For the analyzing and testing of the coals, lignites, ores, and other mineral fnel substances belonging to or for the use of the United States, $100,000 was appropriated. Of this amount, $35,000 will be spent in the chemical and physical investigation of fuels; $25,000 in the inspection of government fuel purchase; $22,000 in fuel efficiency investigations; $5,000 in lignite and peat investigations; and $4,000 in briquetting investigations.

The publications of the Survey relating to mine and fuel investigations, those prepared by the Technologic Branch, will in the future be distributed by the Bureau of Mines. The publications relating to structural materials will continue to be distributed by the Geological Survey. The last of the bulletins of the Technologic Branch to be published by the Survey will be issued from the Government Printing Office about August 1. This bulletin relates to the Explosibility of Coal Dust and was prepared by G. S. Rice, with chapters by J. C. Frazer, Axel Larsen, Frank Haas, and Carl Scholz.

The first of the Bureau of Mines bulletins, the Volatile Matter of Coal, by H. C. Porter and F. K. Ovitz, will be published in the next few months. Then will follow Coal Analyses, by N. W. Lord and J. S. Burrows; Final Data Regarding Steam Tests, by L. P. Breckenridge; North Dakota Lignite as a Boiler Fuel, by D. T. Randall and Henry Kreisinger; Producer-gas Tests in 1905-1907, by R. H. Fernald; The Coke Industry as Related to the Foundry, by Richard Moldenke; Coals for Illuminating Gas, by A. H. White and Perry Barker; and Petroleum for Combustion under Steam Boilers, by I. C. Allen.

CALIFORNIA NO. 2, N. A. S. E.

Newly installed officers of California No. 2, National Association of Stationary Engineers at Los Angeles, are: President, A. M. Woods; Vice-President, J. E. Mackey; Treasurer, Fred Fischer; Recording Secretary, John Topham; Corresponding Secretary, C. G. Bailie; Conductor, H. J. Thompson; Doorkeeper, W. E. Lynam.

N. A. S. E. SMOKER.

California No. 1, N. A. S. E., entertained a large number of the stationary engineers of San Francisco at a smoker and high jinks on July 14, at the association's headquarters on Golden Gate avenue. The program included songs, stories and dances by vaudeville talent and a number of boxing bouts. Supper was served during the performance, after which a number of speeches were given, thus concluding a most enjoyable entertainment which was greatly appreciated by all present.

INDUSTRIAL

NEW HEATING DEVICES.

The General Electric Company early realized that the success of heating devices would depend largely on the superior qualities of the resister or heating element, and the supervision of its manufacture. Expert metallurgists mixed in their crucibles hundreds of combinations of metals and the discovery of a new alloy which was named "Calorite" resulted. This alloy is ideal in its characteristics for this service. It has a high resistance, a high melting point and is non-oxidizing. It is ductile and malleable but is not brittle. The design of the heating element is based on a careful consideration of thermal conductivity, conviction and radiation, also of electrical and thermal insulation, of resultant temperature, and of heat storage. The use of these heating elements in all their designs ensures that the G-E heating devices shall possess superior features.

Leaf Unit Electric Flatiron.

This iron embodies all the essential features of an ideal iron, being the result of a systematic study of the requirements and the gradual evolution of a design which fulfills them. It is well suited for light, medium and heavy laundry purposes and so will give excellent satisfaction in both domestic and commercial work. It is provided with a leaf heating unit which is spread over a broad path around the edges of the bottom surface so that the heat is delivered most directly to the parts of the iron which first come in coutact with the damp material.

Fig. 1. Eight-lb. Leaf Unit Flat-Iron.

Rapid heating and ample heat storage have been combined in proper proportions to make an efficient iron. Three standard forms of connection are provided, the plain attachment plug, the indicating switch plug, and the permanently attached cord. With light or medium work it is advantageous to control the heat regulation by turning the current on or off as required, depending upon the nature of the work. This may be most readily accomplished by means of the indicating switch attachment plug. For very wet or heavy goods, it is generally necessary to keep the current on continuously. The plain attachment plug may be used where there is au occasional demand for continuous heat, as in the ordinary household. The flatiron with the permanently attached cord is especially recommended for laundries and similar establishments where controlling switches and pilot lamps are located conveniently near the ironing board.

The electric flatiron is made for one heat only. Wherever heat regulation is required it may be obtained by turning the current on or off from time to time as previously referred to. About three minutes are required for the iron to heat up sufficiently for light work. These irons may be attached to any lighting circuit, either a. c. or d. c., where the pressure does not exceed 125 volts and consume 650 watts.

Electric Sealing Wax Heater.

This device is designed for use in express offices, banks, shipping departments, stores, and business establishments of all kinds where sealing wax is used for making seals, sealing packages, etc. It is fitted with a removable sheet metal cover, the surface of which slopes downward to a center hole which provides access to the melted sealing wax. This feature of design also allows all drippings to drain back into the pot. This type of heater is most useful for continuous service where large quantities of sealing wax are required.

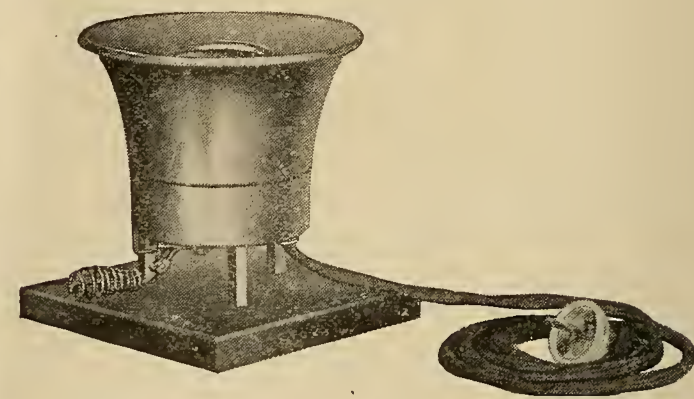


Fig. 2. Sealing Wax Heater.

It has a maximum capacity of 3 lb., and is arranged for three degrees of heat control, "Off," "Low," "Medium," and "High" points, consuming 65, 100, and 200 watts respectively. The maximum heat is used for quick heating aud the minimum heat then maintains a coustant operating temperature.

Electric Celluloid Heater.

During the last few years, the manufacture of celluloid articles has attained great importance, due to the extended use of this material for personal, domestic, ornamental, office and industrial purposes. Since it is moulded while hot, the necessity of constant and exact temperatures is imperative in order to avoid accidents because of its inflammable nature. These requirements are well fulfilled by the 16 x 30 in. electric celluloid heater. By the use of this device the product

Fig. 3. Electric Celluloid Heater.

is made uniform in quality as the same degree of heat is always produced and the work can be duplicated without variation. It is portable and can be easily installed wherever convenient. The heat is instantly available and readily controlled. It replaces high pressure steam with its attendant danger of explosions, leaky pipes, and transmission heat losses.

The standard electric celluloid heaters are available for operation on 100, 110, 120 and 240 volt circuits. They have three degrees of heat regulation, consuming 90, 225, and 450 watts respectively. The maximum heat is used for quick heating as it requires only about 10 minutes to attain the proper temperature. The minimum heat then maintains a constant operating temperature of 150-165 degrees F.

Electric Soldering Pot.

A great advantage of this device is its elimination of the use of coal, gas, gasolene, oil and other dangerous and unhealthful heat producers. It is clean, sanitary, without odor or fire risk, and very convenient. The heat is very easily regulated so as to maintain the molten metal at the proper temperature for best results. It finds extensive application, being suitable for melting lead, solder, babbitt metal, for tinning, dipping, and soldering wires and other small articles, for telephone manufacturing establishments, electrical repair shops, etc.

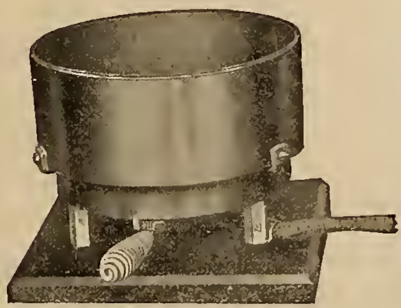


Fig. 4. Electric Soldering Pot.

In construction it is a shallow circular vessel of cast iron, the cup being assembled on top of the heating disc. The heating unit is readily accessible. There are three degrees of heat regulation, consuming 200, 400 and 600 watts respectively. This device is designed for attaching to electric circuits where the potentials are 100, 110 or 120 by standard attaching plug.

Oil Tempering Bath.

In the present age of large manufacturing plants equipped with high speed tools, the cutting steel must be uniform and reliable. This requires the use of hardening and tempering processes which produce absolutely reliable results. The tempering process involves two steps, hardening and drawing. The first step consists in heating the steel to a temperature of from 600 degrees to 700 degrees C., depending on the amount of carbon in the steel, and then chilling it by plunging it into a cold bath. The temper of the tool is then

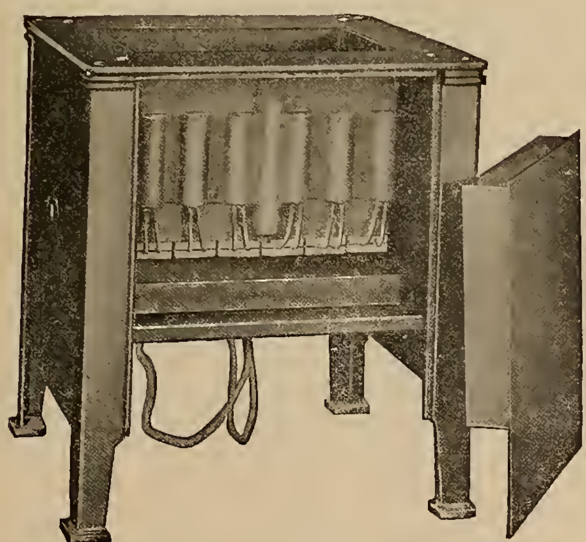


Fig. 5. Electrically Heated Oil Tempering Bath.

"drawn" by heating it to a certain predetermined temperature, after which it is allowed to cool gradually. It has been customary for the workmen to judge this temperature by the color assumed by the metal. This introduced the liability to error of judgment on the part of workmen. Realizing the shortcomings of this process, the General Electric Company has designed a device which eliminates this uncertainty and ensures absolute uniformity in tempering. The steel is suspended in an oil bath, which is provided with a thermometer of precision for registering the temperature. The workman is supplied with a table of temperatures corresponding to certain degrees of hardness in the steel. He places the steel in the bath, brings the latter to the required temperature and maintains it as long as necessary. The device allows one person to temper a larger quantity of steel than is possible by other methods.

Electric Soldering Irons.

The advantages of electrically heated devices are well illustrated by this device. The operation of ordinary soldering irons is expensive and inconvenient, as it involves the intermittent use of gas and sometimes compressed air, and the expense and trouble are also increased by delays, due to continual reheating, waste heat, and frequent necessary renewals. With gas it is impossible to keep the iron at the correct temperature continuously; moreover fumes from escaping gas are of frequent occurrence and a menace, as they vitiate the

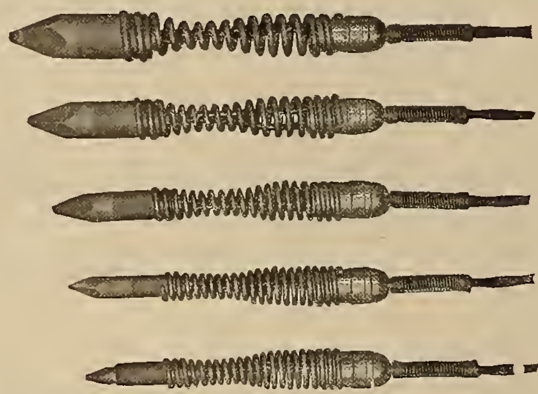


Fig. 7. Soldering Irons Without Guard Rings.

atmosphere and induce fire risk. It is exceedingly difficult to maintain a proper soldering heat outdoors and there are many places which are so confined or so difficult of access that it is almost impossible to use the gas or torch heated tools.

All the above disadvantages are eliminated by the use of electric soldering irons. They are economical, convenient, and reliable, heat quickly, are easily regulated and maintain a constant and uniform temperature. All the heat is generated in the tip where it is available for work. They require

Fig. 8. Soldering Iron With Guard Ring.

only a small current and little attention. There is no accumulation of soot or burning off of the tin at the tip. Being furnished with flexible connectors, they are handy and portable. Work is therefore improved in quality and increased in quantity where the electrically heated irons are used. The irons of the different sizes consume 75, 100, 150, 225 and 325 watts respectively.

Six Slice Toaster.

This toaster has been designed especially for hotels and restaurants. The heating units consist of vertical coils such as are used in the two-slice toasters, and the toasting is similarly accomplished by means of radiant heat. The maximum temperature is almost instantly available after the current is turned on. It is not necessary to turn the slices of bread as the heat acts upon both sides of each slice at the same time,

accomplishing the toasting of all simultaneously. The advantages of the radiant toaster in producing crisp, brown toast are too well known to need further mention. It has a maximum capacity of six slices, each slice being placed in a hinged wire rack, which is located between two rows of heating units. There are thus seven rows of heating units, each row consisting of four vertical heating elements and consuming 500 watts. These are in two sections of three and four

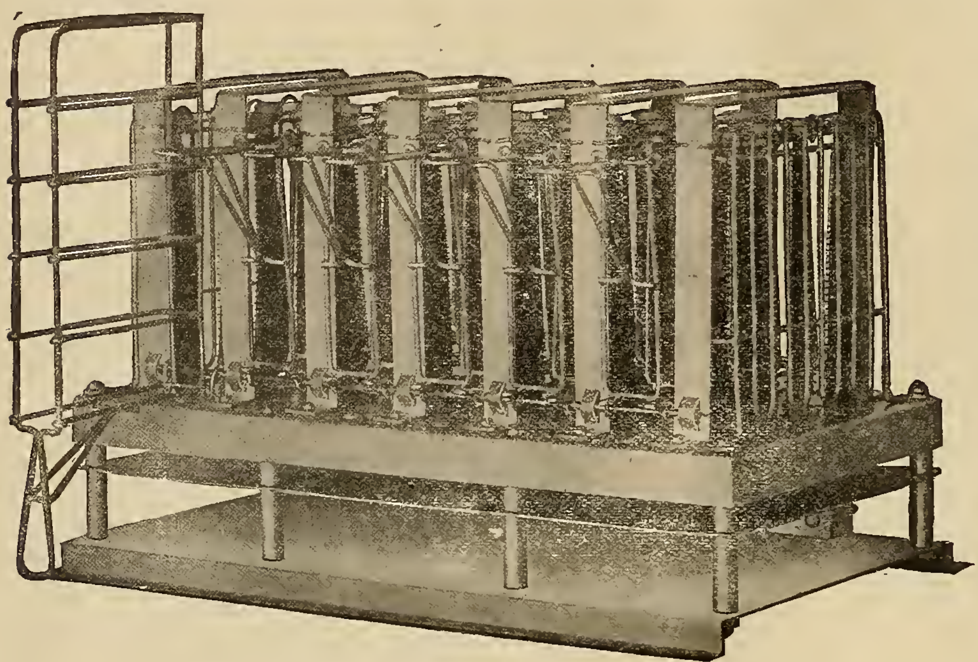


Fig. 6. Six-slice Toaster.

rows each, either section of which may be operated alone or in conjunction with the other, so that 2, 3 or 6 slices may be made at the same time. This instantaneous toaster will be a welcome addition to the kitchen equipment of hotels and restaurants, as it permits toast to be made as fast as one can put in and take out the slices. The use of this device enables the chef to make 6 slices of toast per minute and eliminates the annoyance and expense of maintaining fires to supply an occasional demand for toast. It is designed for attachment to lighting circuit by an indicating snap switch. Each toast rack has a wire handle projecting from the top edge which, when depressed, swings the rack upward and out from between the units.

TRADE NOTES.

The Pacific States Electric Company have opened an office and store at 90-92 Seventh street, Portland, Ore., with a complete stock of electrical supplies, instruments and apparatus.

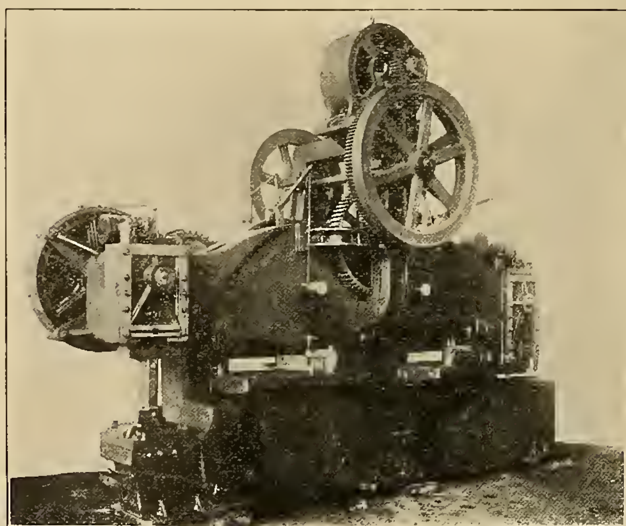
M. P. Schell Manufacturing Company, machinery manufacturers, formerly at 1759 Union street, have moved to 509-11 Howard street, San Francisco. The firm makes all kinds of special machinery and instruments for electric and steam power plants and engineers.

The electric equipment for the Natomas Consolidated No. 8 dredge, the largest gold dredge in the world, has just arrived at Natoma, near Folsom, Cal. This includes over 1000 h.p. in various Westinghouse Type H.F. variable speed and Type C.C.L. constant speed motors, together with switchboard and transformers, all manufactured by the Westinghouse Electric and Manufacturing Company. The buckets on the dredge have the large capacity of 13½ cu. ft. each. The dredge is expected to be in operation next September near Folsom.

UNIVERSAL SHEARS FOR CHANNELS, ANGLES AND PLATES.

The accompanying illustration shows a motor driven universal shear for squaring and mitering channels, angles and plates, used in structural steel work. This machine was built especially for the Marine Department of the Maryland Steel Company, Sparrows Point, Maryland, but would be found very useful in any iron works where steel forms must be cut for construction work. This machine has a coping attachment at one end, a plate shear at the other and two intermediate 45-degree angle shears. The coping attachment can also be used as a punch. The plate shear will cut angles up to 6 in. by 6 in. by 1 in. or 8 in. by 8 in. by ¾ in. and channels up to 15 in. by ¾ in. Each shear is controlled by its own clutch, and the machine can be operated simultaneously by three groups of men without interefering with one another.

The frames, plungers, pendulums, clutches, and all parts subjected to severe shock are semi-steel castings. The shafts are made from hammered steel containing from .4 to .5 of one per cent carbon. The gears are provided with long hubs which extend through the gear casings. Particular attention has been given to obtaining satisfactory lubrication for all bearings. An especially designed automatic stop motion on each shear throws out the clutch when the shear reaches the highest point of its travel, while a similar automatic stop on the coping device is adjustable, thus allowing the plunger



Universal Shears for Channels, Angles and Plates.

to be stopped at any predetermined point in its downward stroke.

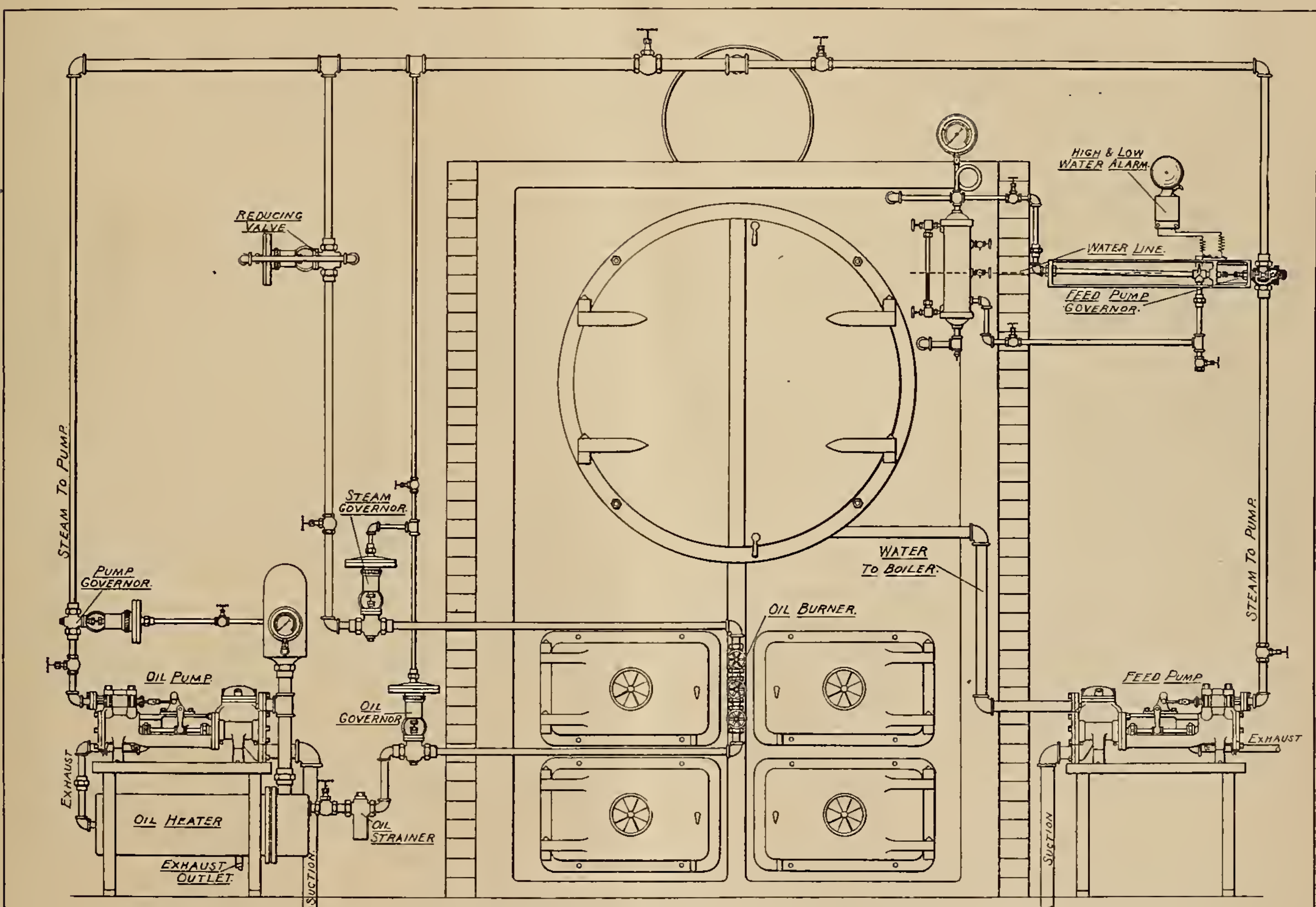
The net weight of this machine is approximately 23 tons and it is designed throughout for long life under most severe service. It is built by the Covington Machine Company of Covington, Va., and is equipped with a 25-h.p. type S direct current motor manufactured by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

WITT AUTOMATIC FEED WATER REGULATOR AND OIL BURNER GOVERNOR.

The accompanying illustration shows the G. E. Witt Company's automatic oil burner governors and boiler feed water regulator. The most essential thing in the operation of a steam boiler is the close regulation of the feed water and the constant steam pressure, which is almost impossible to accomplish by hand regulation. The advantages of automatic regulation include a great saving of fuel and labor, increase in capacity of the plant and fewer repairs on the furnace and boiler.

This boiler feed regulator is operated by expansion and contraction. This device is simple in construction and has but one wearing part entirely external to the boiler, the expansion member consisting of a brass tube placed in a frame and located on a level with the desired water level in the boiler, one end of the tube being connected to the tube of column. As the water rises in the boiler it also rises in the tube, causing it to contract. This closes the valve and slows down the boiler feed pump which causes the water to recede in the boiler and tube until the steam enters the tube, which causes the same to expand and open the valve to the feed pump. The brass tube in this regulator being placed on a level, it requires but slight movement of the water to operate the valve. This feature insures a close regulation of the water.

The automatic oil burner regulation consists of two governors and one reducing valve, a reducing valve and one governor being placed on the steam pipe to the burner and one governor on the oil pipe leading to the burner. The oil and steam governors are set at the desired boiled pressure, the diaphragm being connected to the drum or main steam pipe of the boiler. As the load increases on the boiler, the steam pressure will decrease, thus causing the governors to open and increase the flow of oil and steam to the burner. Should the load decrease, the boiler pressure will rise, causing the governors to close the flow of oil and steam to the burner. The reducing valve is used in order to get a reduced pressure which is more economical and noiseless.



G.E. WITT CO'S OIL BURNER GOVERNORS & AUTOMATIC FEED-WATER GOVERNOR.

TRADE NOTES.

The Robinson Manufacturing Company of Everett, Wash., has placed an order with Allis-Chalmers Company for a 155 k.w., 900 r.p.m., 60 cycle, 3-phase, 480-volt alternator, one 60 h.p., one 40 h.p. and one 20 h.p. squirrel cage induction motors. These will be installed in a new plant which the company is now constructing.

Allis-Chalmers Company recently sold a turbine to the Standard American Dredging Company of San Francisco. This company is one of the largest dredging concerns in the United States and has many boats on the Pacific Coast and on the Gulf. The turbine, which is a standard 500 k.w., 2300-volt, 3-phase, 60-cycle, 3600 r.p.m. machine, will be installed on one of its largest dredges and will furnish power for driving a 500 h.p. motor direct connected to the dredge pump. The alternator will receive exciting current from a 15 k.w. Allis-Chalmers generator direct connected to an American Blower Company's engine. Steam will be supplied at 175 lbs. pressure and 100° F. superheat.

NEWS NOTES

FINANCIAL.

KENDRICK, IDAHO.—A special election will be held in Kendrick, Idaho, by electors for the purpose of bonding the town in the sum of $10,000 for the purpose of maintaining a system of waterworks.

SANTA BARBARA, CAL.—A resolution of intention to call a bond election for $200,000 water bonds has been adopted by the City Council in accordance with previous recommendation of the water commisisoners.

ASHLAND, ORE.—The city election held for the purpose of voting on two bond issues resulted in carrying both propositions, one of which was the proposition of bonding for $25,000 for the completion of the electric light and power plant.

INCORPORATIONS.

ADRIAN, WASH.—The Adrian Power & Water Company, capital, $457,000, has been incorporated by E. P. Colman, H. Lessing and H. W. Mangoad.

LOS ANGELES, CAL.—Devore Water Co., $310,000, subscribed, $1000, by T. S. Wadsworth, C. W. Hollister, W. W. Brown, J. A. Crandell and S. J. Parsons.

SAN FRANCISCO, CAL.—The Ideal Electric Company has been incorporated by M. B. J. Gerke, F. L. Gerke and H. F. Sullivan, with a capital stock of $10,000.

SALT LAKE CITY, UTAH.—The Electric Railway Company has been incorporated by business men of this city, with a capital stock of $1,500,000. The purpose of the company is to build and operate an electric railway from Salt Lake City to Utah county points. Construction work will begin this summer.

PRINEVILLE, ORE.—A. compauy of Prineville men composed of W. A. Booth, president; Warren Brown, secretary-treasurer, and D. Stewart, G. Cornett and W. Brown as board of directors, has filed articles of incorporation. The company will generate electric power for operation of all kinds of machinery, and will own and operate grist mills. The principal office is at Prineville; capital stock $50,000. The location of the plant of the new company will be at Cove Orchard on Crooked river. Six thousand horsepower will be developed.

TRANSMISSION.

GROVELAND, CAL.—Manager Graham of the Good Ship Mines, is preparing to install an electric power plant here at once.

TACOMA, WASH.—Light and Water Commissioner Lawson announced that no bids were received for the construction of the $95,000 sub-station of the Nisqually power plant.

NEW WESTMINSTER, B. C.—The Vulcan Boiler Works of this place has secured the contract for the coustruction of two miles of pipe for the Vancouver Island Power Company's projected plant at Jordan river, on the island.

PLACERVILLE, CAL.—Notice of an appropriation of 50,000 inches of the water of the Rubicon river has been filed with the county recorder by H. H. Baker. The water will be diverted at a point on the river about a quarter of a mile below what is known locally as Grasshopper bar. The purpose of location is for the generation of electricity for the operation of railroads.

NEW WESTMINSTER, B. C.—The Canada Power Company of Stave Falls is considering the proposition of putting in transmission wires from the falls to Pitt river, thereby furnishing light to the towns of Haney, Hammond and other points.

LEWISTON, IDAHO.—It is reported that the Lewiston Clarkston Investment Company has closed a contract with the Washington Water Power Company of Spokane for the electric current to be received at Moscow on a new transmission line to be constructed from Palouse to Moscow to conect there with the Lewiston system.

SPOKANE, WASH.—J. L. Harper, representing the North Washington Company, has closed a 10-year lease for the Similkameen power plant, near Oroville, Wash. The North Washington Company, which owns and operates an electric light and power plant at Republic, Wash., will develop the Oroville plant itself to a point where it will be capable of supplying not only all the demands of the Republic district for power by means of a transmission line, but also those of many large irrigation enterprises in Okanogan County, which are entirely dependent on it.

GREAT FALLS, MONT.—The first two units of 6000 h.p. each of the Rainbow Falls development at Great Falls, Montana, have recently been successfully started. According to Mr. Chas. T. Main, of Boston, the engineer in charge of this work, the other four units of 6000 h.p. each in this development will be in operation sometime in August. The Rainbow Falls is the second largest of the five falls in the Missouri river at Great Falls, Montana, having a fall of 54 feet. There is an aggregate drop of 433 feet in the Missouri river within 5 miles, with a total possible development of about 330,000 h.p.

ILLUMINATION.

WILSON CREEK, WASH.—The City Council has granted a 50-year franchise to C. J. Weller to operate an electric light and power plant in Wilson Creek.

SANTA ANA, CAL.—The unincorporated town of Garden Grove has petitioned the Supervisors to call a special election of the town to vote upon maintaining a street lighting system.

OLYMPIA, WASH.—H. H. Hyde has made application to the Board of County Commissioners of Thurston County for a franchise to construct and maintain a pipe line for conducting of gas to be used for light and heating along the roads of Thurston County.

LOS ANGELES, CAL.—The Board of Supervisors is receiving sealed bids for furnishing necessary equipment and for lighting with electric lights certain streets in Downey Lighting District in accordance with specifications on file with the Board of Supervisors.

SAN FRANCISCO, CAL.—Sealed bids will be received by the Board of Public Works in the David Hewes Building, 995 Market street, San Francisco, between the hour of 10 and 11 a. m. on Friday, July 29, 1910, for doing the electric work of the Burnett School Building.

LINCOLN, CAL.—C. E. Young, superintendent of the Marysville division of the Pacific Gas & Electric Company, has been looking over the local situation with a view to improving the general lighting service in Lincoln. The system will be practically rebuilt and in a short time day service will be installed.

COLFAX, WASH.—President Henry M. Richards of the Washington Water Power Company, has made several liberal offers relative to the street lighting and the water system of Colfax, and agreed to give the city light, remodeling the whole system, at less cost than heretofore.

LOS ANGELES, CAL.—The Stacey Manufacturing Company of St. Louis has sent its representative, Mr. C. H. Gleeson, with several men, to Santa Barbara, to erect the new gas plant of the Santa Barbara Gas & Electric Company. The foundations have all been placed under the direction of the local manager, and work will proceed rapidly.

SAN FRANCISCO.—The Pacific States Electric Co. and other creditors of the Light Store of Oakland, have brought an involuntary action in bankruptcy against the firm in the United States district court. It is alleged that the firm committed an act of bankruptcy on the ninth of the month, by admitting that it could not meet its financial obligations.

MANILA, P. I.—Mr. Patrick J. Moore, formerly a lawyer of this city but now practicing in Zamboanga, is in Manila at present on his return to Mindanao. Mr. Moore came to this city on business connected with the securing of a franchise for a water and heat, light and power plant for the city of Zamboanga. The franchise has been approved by the municipal council and now awaits the approval of the Commission.

SAN FRANCISCO, CAL.—U. S. District Judge Van Fleet, sitting in the Circuit Court has continued the hearing in the matter of the order to show cause, issued against the city at the instance of the Metropolitan Light and Power Company, until September 5. It was agreed also that instead of putting up an indemnity bond, the gas company should impound the excess collected by it over and above the rate fixed by the Supervisors, which forms the hasis of the suit.

TRANSPORTATION.

CORONA, CAL.—It is reported that the Pacific Electric Railway Company will soon begin work on another 12-mile extension toward Riverside and that the road will be in Corona by January 1, 1911.

GLENDALE, CAL.—The residents of Monte Vista and Sunland are trying to form a combination with citizeus of Crecenta to raise a sufficient bonus to induce E. D. Goode of Glendale and the Eagle Rock Railway Company to extend that line to their respective towns.

CITY OF MEXICO.—All but one block of the first half of the general hospital electric line running south from Avenida de Chapultepec to the hospital, has been completed. Work will then begin on the loop, which will bring the cars in that service back to the city by the way of Calle de Jose M. Vertiz.

NORTH YAKIMA, WASH.—President N. C. Richards of the Yakima Valley Transportation Company has arranged for installing $20,000 worth of machinery at its yards. The building will be of stone and cost $10,000. It is announced that the company expects to build and operate seven city electric lines.

PORTERVILLE, CAL.—An ordinance has been passed granting to F. U. Nofziger, associates and assigns for the term of 50 years from the first day of July, 1910, a franchise to lay and maintain railroad tracks and to pass with and operate a steam or other motive power railroad along certain streets and portions of streets in this city.

ALBUQUERQUE, N. M.—Actual construction of the new trolley line to Highland is now finished and all that remains is to place cars upon it. The Board of directors has met and discussed financial matters authorizing Secretary Barth of that board to go to Denver to conclude a deal for the placing of the bonds of the company. The Western Securities Company of Los Angeles is the company with which negotiations are under way.

WATERWORKS.

MODESTO, CAL.—The city clerk has been authorized to purchase 800 feet of 2-inch water pipe.

VALLEJO, CAL.—The United States Pipe Company has been awarded the contract for furnishing 2000 feet of 4-inch water pipe to the city.

BISHOP, CAL.—The Trustees have awarded to Leece & Watters for about $585, a contract for furnishing 1000 feet of 4-inch pipe on standard hydrants, etc.

DAVIS, CAL.—Mr. Van Zandt, a representative of the Pacific Gas & Electric Company, has obtained a sufficient number of signers for water and probably the company will install a system here.

TACOMA, WASH.—The council has passed a resolution providing for the construction of a 6-inch cast iron water main in Melrose street and South Fifteenth street from Junett street, to Cedar street and on Cedar street from South Fifteenth to South Fourteenth streets.

LOS ANGELES, CAL.—The Council has referred the communication of the Civic Association of Pasadena relative to securing the Owens river water for Pasadena, to the water commissioner. Mayor Alexander has requested that immediate attention be given to the proposition of supplying outside municipalities with surplus water when the aqueduct is completed.

LOS ANGELES, CAL.—Underground watering of Central Park is to be tried by the park board. The commission has passed on a pipe system by which Central Park is to be underlaid with 2-inch pipes with spray outlets at close intervals throughout the park. If the experiment is successful the system will be installed in other parks. Central Park, it is predicted, can be watered in 30 minutes by the new system.

SEBASTOPOL, CAL.—The population of Sebastopol has grown to such an extent during the past two years that it is necessary to increase the supply of public water. The present water system consists of a large well and a 212,000 gallon reservoir, in addition to a spring which is situated several hundred feet from the well. There are great possibilities for development in the spring and the Trustees will take the matter up at once.

LOS ANGELES, CAL.—With $2,235,000 at hand to fill the depleted treasury immediately and meet all expenditures between now and December 1st, when the next bond installment will be purchased under option, the Owens river aqueduct can again be pushed forward. The aqueduct work faced a financial crisis several weeks ago. The New York bond syndicate, which took an option on the entire bond issue of $25,000,000, found that the work was progressing so rapidly that it required bond purchasers with greater frequency than the Eastern financiers cared to buy. The crisis became so acute that the Mayor sent a special message to the Council urging that immediate steps be taken to meet the emergency. A committee was appointed. The banks were appealed to. All responded with offers to buy as much as needed. Two Eastern insurance companies purchased $1,000,000 worth of the bonds. More were taken by local institutions and the rest of the money was raised by selling the bonds to the city itself, employing part of the sinking fund provided to retire the bonds.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 5 | SAN FRANCISCO, JULY 30, 1910 | PER COPY, 10 CENTS

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VOLUME XXV SAN FRANCISCO, JULY 30, 1910. NUMBER 5

MECHANICAL EQUIPMENT OF THE PALACE HOTEL

BY T. B. HUNTER AND R. A. HUDSON.

The Palace Hotel, San Francisco.

The Palace hotel, the largest hostelry on the Pacific Coast and one of the most widely known in the whole world, was erected by Senator William Ralston in 1875, on the block of land at Market and New Montgomery streets. At that time it was the largest hotel west of New York and in point of architecture, appointments and special features was a marvel among the hotels of both hemispheres. Chief of these features was the grand court 87 ft. by 133 ft., around which the building was built. The Palace was the rendezvous of all world travelers, students, statesmen, money kings, actors and society folk of importance who came to the Pacific Coast, and became the social political and industrial center of California. Here were

held the great society functions of the bonanza days, when $50,000 was spent in a single night, to celebrate the triumph of some social favorite. Here politicians met and careers were made and unmade. Here business men, mining magnates and industrial barons foregathered and over the little tables made deals that meant millions.

In the catastrophe of 1906, the Palace went through the earthquake unscathed, but fell victim to the fire which followed. It was completely gutted, but its walls remained unharmed. While other hotels in San Francisco were merely repaired and rebuilt, the Palace Hotel Company decided to erect an entirely new building for its guests. It took more than six months to tear down and clear away the old building. The new hotel was opened December 15, 1909, in an absolutely new and fireproof building. It presents all the famous features for which the old Palace was famous, with many new ones exclusively its own, making the Palace the most modern hostelry, and presenting a superior example of hotel construction and equipment. The Palace covers two and one-half acres in the heart of San Francisco's banking and business centers. It rises nine stories and is built of steel, concrete and brick.

The mechanical equipment of the Palace hotel includes a complete electric plant of 900 k.w. rated capacity with foundation for one additional 300 k.w. unit for future business; complete wiring systems for lights, motors, telephones, bells and clocks; a complete pumping plant for elevators and house service; water filters capable of filtering 452,000 gals. per 24 hrs. with necessary storage tanks, etc., and provision for the future installation of a water softener plant; an ice making and refrigerator plant of 35 tons of refrigerating capacity; a complete system of direct steam heating for the sleeping floors and an indirect system for the basement, main floor and the bath rooms on the sleeping floors; and a complete vacuum scrubbing and sweeping plant.

Engine and Boiler Room

The engine and boiler room is in the basement near the Market street side. The top of the engine room floor is 30 ft. 3½ in. below the Market street sidewalk and 5 ft. below the mean level of the ground water. The bottom of the engine foundations is 10 ft. below the engine room floor.

To counteract the upward pressure of the ground water, a special floor 3 ft. thick was placed. This floor was made of copper slag concrete mixed in such proportion that the weight of the concrete, as determined by test, was 190 lb. per cu. ft. For a floor 3 ft. thick this gives a total weight per square foot of floor of 570 lb. which is sufficient to counteract the upward thrust due to the ground water pressure which in this case is 500 lb. per sq. ft. of floor.

This floor is cut by pipe trenches varying in width from 12 in. to 10 ft. 9 in., and in depth from 12 in. to 2 ft. 6 in. The bottoms of the trenches were reinforced with steel rods and thickened so as to transmit the stresses to the adjacent uncut portions of the floor and the building column footings.

The entire engine and boiler room floor was waterproofed with 5-ply Hydrex felt laid six inches above the bottom of the 3 ft. slab. This waterproofing was carried up the side walls and all columns penetrating the floor slab to a point 7 ft. above the floor level.

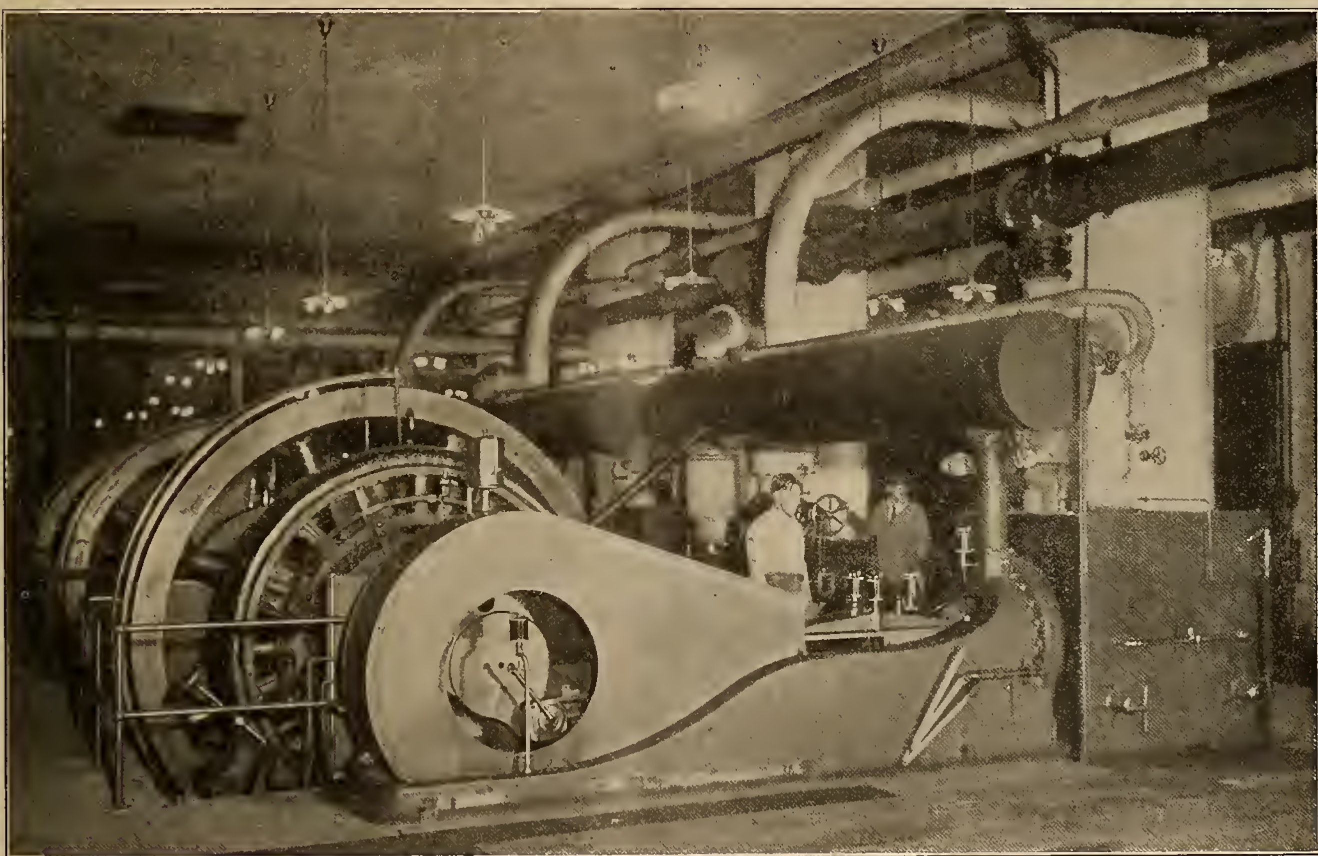
Two open concrete sumps extending to a point 5 ft. 6 in. above the engine room floor were built to act as reliefs and overflows in case a raise in the ground water level should increase the upward thrust on the floor greater than that for which it was designed. In one of these sumps is a 2 in. centrifugal pump direct connected to a 3 h.p. Westinghouse d.c. motor. In case the water level could not be controlled by this pump, the overflow from the sump will run through the trenches to the two sump tanks and be pumped into the sewer by the sump pumps or the 7 in. centrifugal circulating water pumps.

Boiler Room.

The lower 7 ft. of the engine foundations was placed before the engine room floor was laid, and was carried up to the bottom of the floor slab. The top 3 ft. corresponding to the floor thickness, was placed at the same time the floor was laid. In order to prevent vibration being transmitted from the engines to the building columns through the engine room floor, which was bonded to both the engine foundations and to the building columns, special care was exercised in the design of this part of the plant. The engine foundations were made extra heavy, being for the four units a monolithic mass 85 ft. long, 10 ft. deep and varying in width from 21 ft. to 27 ft. 4 in. The original column schedule provided for a row of columns in the center of the engine room. The footings of these would have been under the engine foundations or so close to them that there would have been great danger of vibration being transmitted through the columns to the steel frame of the building. The row of columns was removed and the load carried to the adjacent ones by plate girders. Around each column of the two rows on the opposite sides of the engines, was cast a concrete casing 4 ft. by 4 ft. running from the

column footing to the engine room ceiling. This casing was bonded to the engine room floor with reinforcing rods. The inertia of the mass of concrete in the engine foundations, engine room floor and column casings was estimated to counteract and absorb the vibrations of the engines before reaching the steel frame of the building.

As an additional precaution, the fly wheels of the engines were made heavier than the standard for machines of this size. One of the reasons for using cross compound engines instead of the tandem type was that probably the pistons of the three or four engines of the tandem type of the same size and running at the same speed would often run in step. The effect of this would be to impart to the foundations and floor a swaying motion corresponding to the strokes. With the cross compound type with cranks 90 degrees apart the danger from this would be minimized. It was thought that the elimination of all vibration warranted the extra expense of the cross compound type as well as the extra cost of the column casings.



McIntosh & Seymour Engines, each driving 300 kw. Westinghouse Generator.

Boilers.

The present installation consists of three Babcock and Wilcox boilers of the inclined wrought steel header type, designed for 200 lb. working pressure. Each boiler is set singly and is made up of 18 sections of 18 ft. by 4 in. tubes, 10 tubes high, with two steam and water drums 42 in. diam. Each boiler contains 3749 sq. ft. of heating surface.

The guaranteed efficiency of the boilers is 79 per cent at rated capacity with California crude oil, having a calorific value of 18500 B.t.u. per lb. with a limit of water, sand and silt of ½ per cent. Each boiler is fitted with a Babcock and Wilcox superheater which will heat the steam from 100 degrees to 120 F. above the temperature corresponding to the working pressure of 200 lb. per sq. inch. Space has been provided for the installation of two additional boilers should the outside load on the plant make it necessary.

Breeching and Stack.

A reinforced concrete breeching with two compartments, making provision for the installation of a fuel economizer extends across the rear end of the boilers. This breeching is equipped with eight explosion doors which will open and relieve the pressure in case of gas explosion in the breeching. These doors are hinged and counterweighted so that as soon as the force of the explosion is relieved they automatically close.

On account of changes in the alignment of the breeching both horizontally and vertically for the short distance between the boiler nearest the stack and the stack, this portion of the breeching was made of riveted steel. The steel portion is covered with 2 in. magnesia blocks, canvas wrapped, with a 2 in. air space between the magnesia and the steel.

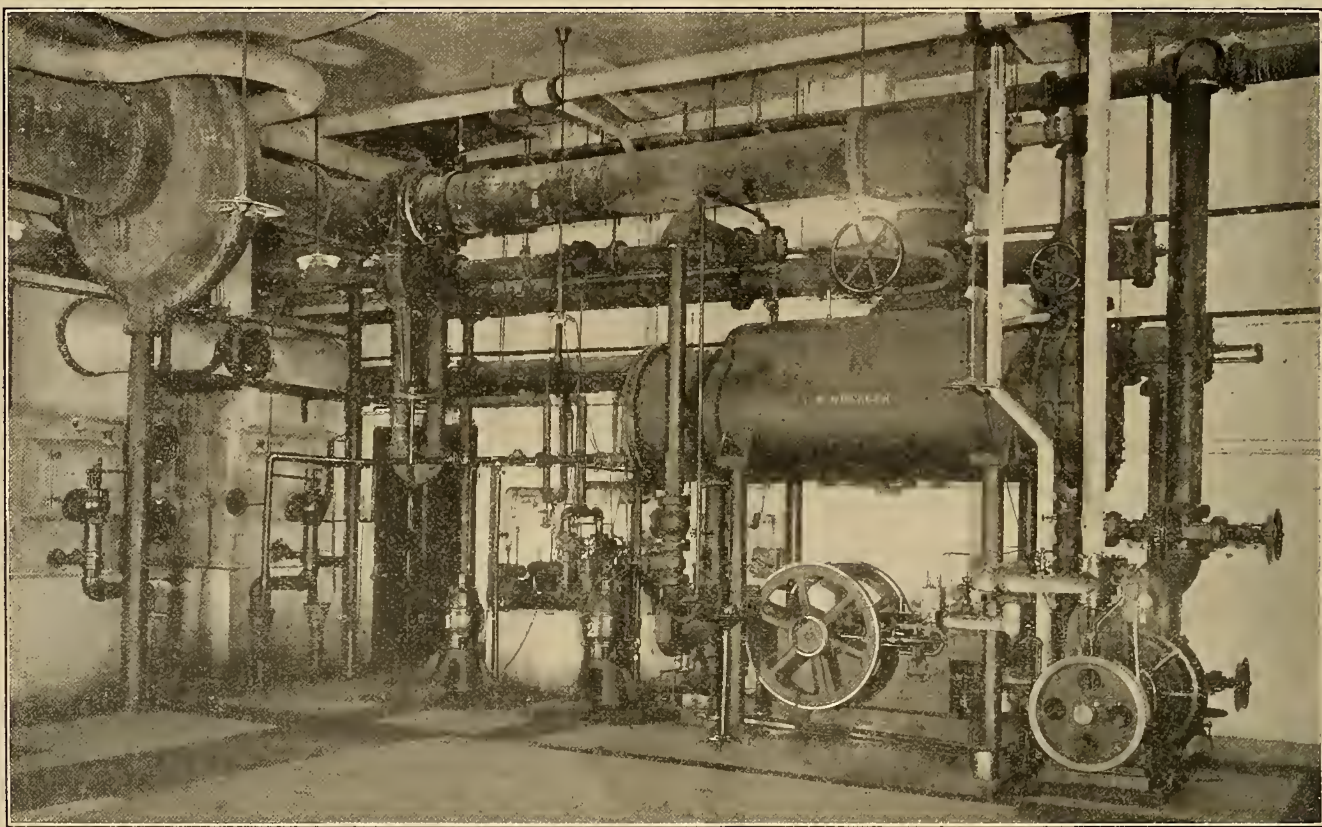
In the stack compartment, a 12 by 12 ft. shaft running through the building from the basement to the roof, is placed the smoke stack. This is of riveted steel construction 66 in. diameter by 168 ft. high and was built in place. It is self supporting but is stayed laterally at the second, fifth and pent house floors by roller-guides riveted to channels crossing the stack compartment.

Engines.

The present engine installation consists of three horizontal, cross compound, McIntosh and Seymour engines, each direct connected to a 300 k.w. generator. The engines run at 150 r.p.m. The principal dimensions of the engines follow: Diameter h. p. cylinder 14 in.; diameter l. p. cylinder 30 in.; stroke 30 in.; weight 88,000 lb.; diameter fly wheel 11 ft.; weight fly wheel 16,000 lb.

The re-heating receiver is placed above the cylinders as herewith shown, on account of the difficulty and cost of making a water tight pit below the cylinders.

Force feed lubricators are provided for each cylinder. The main bearings are fitted with a self-oiling device consisting of settling tank in the engine frame from which a pump, driven from the valve gear, delivers a continuous stream of oil to the bearings. The main bearings are also fitted with cylindrical hollow shells for water circulation. Water is taken from the cold water system of the house, passed through these bearings and run to the hot well as "make up water."



Condenser Equipment.

Condenser Equipment.

One complete condenser unit was installed, consisting of one C. H. Wheeler surface condenser with 2000 sq. ft. cooling surface; directly beneath the condenser is a 6 in. by 12 in. by 10 in. Wheeler-Mullan horizontal suction valveless steam driven vacuum pump. The circulating water pump is a 7 in. Krogh centrifugal direct connected to a 7 in. by 5 in. Ohmen, vertical, marine type high speed engine. While the operating head on this pump is the height of the cooling tower plus pipe friction the static head is approximately 170 ft. on account of the cooling tower being on the roof. In order to withstand this head an extra heavy shell was provided on both this pump and the water chambers of the condenser.

On the roof is one Wheeler-Pratt forced draft water cooling tower of sufficient capacity to cool the water for condensing 12,000 lb. steam per hour at 26 in. vacuum. The tower is fitted with one 10 ft. disc fan direct connected to a 15 h. p. Westinghouse motor with a maximum speed of 225 r.p.m. This motor is fitted with a speed controller for varying the speed from half to full speed.

A 12 in. circulating line connects the condenser and pump in the basement with the tower on the roof. On the pump discharge line near the pump is placed a Crane No. 41 E automatic stop and check valve to prevent the flooding of the basement should a break occur on the pump side of the valve. On the return or suction side of the pump is placed a Crane triple duty emergency valve No. 35 E for the same general purpose.

This condenser unit was designed to handle 12,000 lb. steam per hour at 26 in. vacuum. Provision was made for a duplicate unit. All piping is arranged for this addition and the tower shell placed ready to receive cooling surface, which consists of a mat of wood strips.

The condenser is above the engine room floor, and consequently much above the low pressure cylinders of the engines. The 12 in. exhaust pipe from each engine runs in a floor trench to the nearest building column and up along side of it to the main exhaust pipe which runs just under the ceiling across the engine room to the condenser.

Special provision was made for draining the condensation from the low pressure cylinder and the part

of the exhaust lines in the floor trenches and on the columns, by vertical shaft submerged centrifugal pumps, enclosed in cast iron tanks set in the floor below the bottom of the exhaust lines. These pumps and tanks drain the exhaust line when the engines are running condensing as well as non-condensing.

The discharge from these pumps may be either into the condenser shell or into the hot well, depending on whether the engines are running condensing or non-condensing. A by-pass to the sump is also provided which can be used for draining when running non-condensing. These pumps are 2 in. standard Krogh pumps and are direct connected to 3 h.p. vertical motors.

Boiler Feed Pumps.

The boiler feed pumps are two Snow horizontal, duplex outside center packed plunger pumps 10 in. by 6 in. by 10 in. each capable of feeding a maximum of 1500 boiler horsepower.

A 2 in. connection was made from the discharge of one of these pumps to supply water to operate the Lagonda boiler tube cleaner. The water supply is furnished by a 3 in. connection from the cold water House service to the suction of the pump.

Heaters and Hot Well.

Two Cochrane open type feed water heaters and receivers were installed, each with capacity to supply 1600 boiler horsepower. An auxiliary open hot well tank with oil filter was also installed. This is above the Cochrane heater so that the water flows by gravity to the heaters. All drains and returns go to the auxiliary hot well or to the Cochrane heaters should the hot well be emptied for cleaning. The feed pumps draw their supply directly from the Cochrane heaters.

Fuel Oil System.

California crude oil is used for fuel in both the power plant and kitchen ranges, one system supplying both sets of fires. The main storage tanks are under the Annie street sidewalk outside of the building line. There are seven of these tanks with a total storage capacity of 497 barrels.

By a city ordinance, tanks from which oil is fed to burners must be placed below the level of the burners, but the cost of doing so in this case was prohibitive. In order to comply with the ordinance and still leave the tanks as high as possible, an auxiliary tank was placed under the Market street sidewalk at a level lower than the burners. But the ordinance would not allow of a gravity flow from the main tanks to the auxiliary tank so a small pump room was built close up under the first floor and above the level of the main tanks. In this room are two 6 in. by 4 in. by 6 in. Worthington duplex, direct acting steam pumps for pumping the oil from the main tanks to the auxiliary tank.

The auxiliary tank has a capacity of 52 bbls. and from it the main fuel oil pumps supply the burners in the power plant and the burners in the kitchen ranges. The main oil pumping sets are in duplicate, each consisting of one 4½ by 2¾ by 4 in. duplex, direct acting pump mounted over an oil heater. Each boiler is equipped with a Witt oil regulator which regulates the main steam pressure.

Blow Off and Sump Tanks and Pumps.

The boiler blow off tanks, each 4 ft. 6 in. by 17 ft. long, are buried in the engine room floor. One tank is fitted with a Blake vertical direct acting submerged plunger pump 8 by 5¾ by 12 capable of emptying the tank into the sewer in 16 minutes. The tanks are inter-connected.

Two sump tanks are provided for the floor drainage and also to receive all trap drains that contain oil. These tanks are 4 ft. 6 in. dia. by 17 ft. long, and are buried in the floor. Each tank is fitted with a Worthington duplex vertical plunger pump size 6 by 9 by 6 capable of emptying the tank into the sewer in 4 minutes. The pumps are automatically controlled by floats in the tanks which operate quick opening throttle valves in the steam line to the pumps by a system of levers. Each tank is also connected to the 7 in. circulating water pump of the condenser outfit, which can be used to pump out the tanks in case the engine room is flooded.

Lubricating Oil Filter and Storage Tanks.

Six galvanized iron tanks, each of 1 bbl. capacity are provided for the storage of lubricating oil. A 3 in. pipe was laid from the Annie street sidewalk to the tanks for filling, so that it is not necessary to handle the oil barrels in the engine room.

A Turner oil filter with a capacity of 60 gals. per day is placed on a gallery above the storage tanks. The drains from all oil separators are pumped to this filter and after passing through the filter the oil flows by gravity to the proper storage tank. The filtered cylinder oil is used to enrich the engine oil, which is also filtered through the same filter.

Piping.

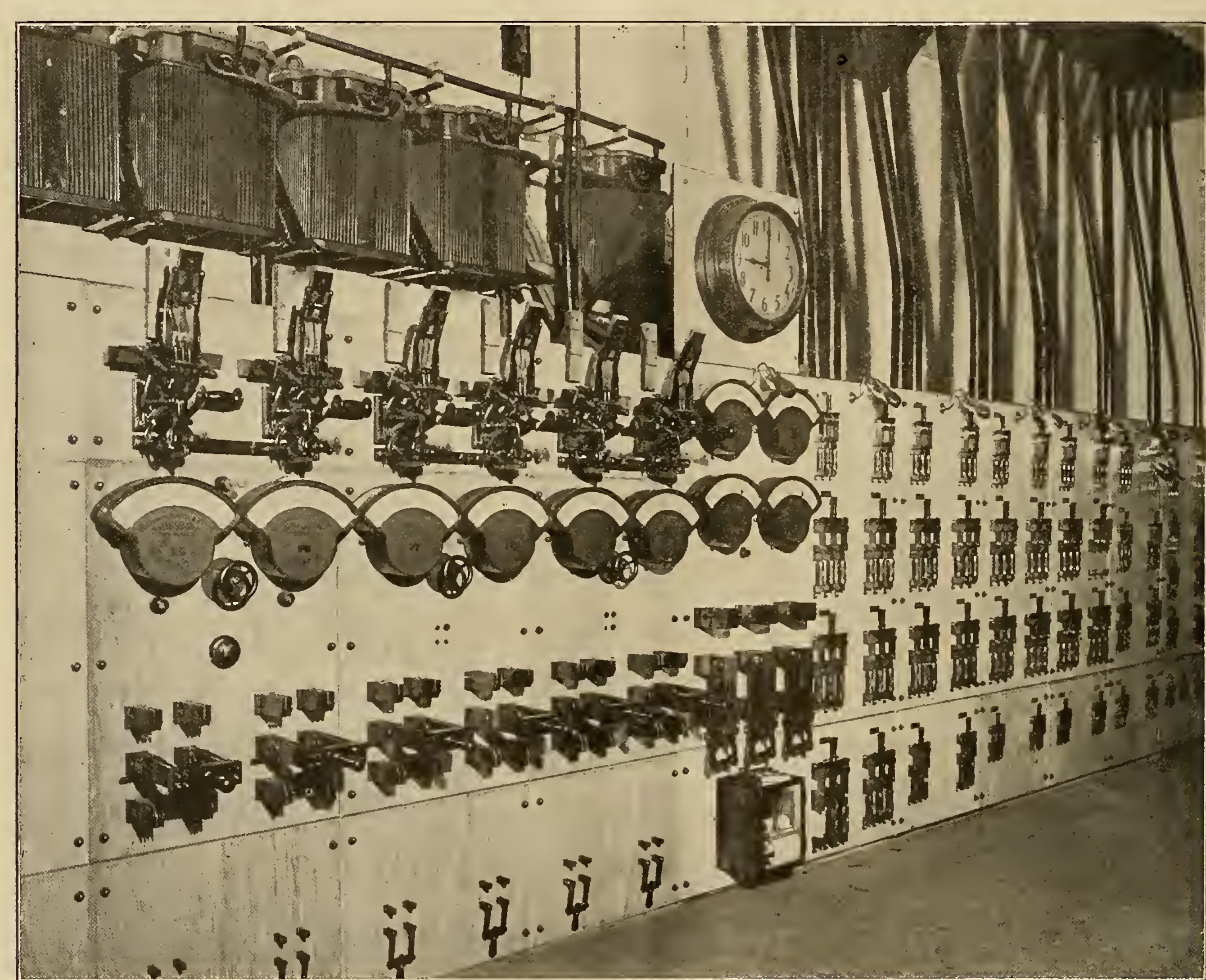
All high pressure lines for 200 lb. steam, boiler feed and blow off are extra strong, soft flanging pipe with Van Stone joints on all lines 5 in. in diameter and over. All fittings are extra heavy cast iron. All joints on high pressure lines were made with corrugated copper gaskets. Low pressure live steam lines not over 100 lb. pressure and water lines are standard pipe with cast iron fittings. Large exhaust lines are cast iron. Small lines standard wrought pipe. All steam and exhaust piping is covered with 85 per cent carbonate of magnesia canvas covered, held in place with metal bands. All drains not containing oil are piped into a header leading to the hot well and heaters. Drains containing oil are piped into a header leading to the sump.

Each boiler is fitted with automatic stop and non-return valve in addition to the gate at the main steam header. Valves are Chapman and Crane manufacture. On all high pressure steam lines, outside screw, rising stem valves were used. Valves 5 in. and over are fitted with by-pass.

All overhead steam exhaust and pump discharge piping is supported from the engine room floor by supports made of standard pipe or structural shapes, except over the boilers, where it is supported on the boiler frame work or setting. This provision was made to prevent vibration and noise reaching the upper stories of the hotel through the steel frame which would be the case if the piping was hung from the floor slab.

The main exhaust line to the condenser is fitted with a 30 in. Cochrane vacuum oil separator drained by two pumps 4 in. by 4 in. by 6 in. discharging into the Turner oil filter. The two exhaust lines supplying steam to the heating system are fitted with 14 in. and 10 in. oil separators also draining to the oil filter.

All vapor pipes and vents are in the stack compartment. The main atmospheric exhaust is 20 in. diameter made of No. 10 gauge riveted galvanized iron. It is fitted at the roof with a Burt exhaust head, the condensation being piped back to the auxiliary hot well. The main exhaust pipe is fitted with an automatic back pressure and relief valve.



Generator and Lighting Feeder Panels of Switchboard.

Generators.

Direct connected to each engine is a 300 k.w., 250-volt, 150 r.p.m. three-wire, Westinghouse generator. The balancing coils on the two-phase a. c. connections for balancing the load on the two sides of the 3 wire system are mounted on the engine room wall behind the switchboard.

Switchboard.

The switchboard, 45 ft. 4 in. long, divided into 17 panels each 32 in. wide, is located directly in front of the generators, as shown in the accompanying illustration, the arrangement being as follows:

Near the center of the board are the three generator panels, composed of blue Florentine marble, divided into three slabs, the upper slab being 20 in. high, the middle 45 in. high and the lower 25 in. high. On each of these is mounted

2 1500-ampere, single-pole, type "C" Westinghouse carbon circuit-breakers, each with equalizer contact. These two breakers are connected to a common cross arm, so that they may be closed independently, but will trip together.

2 2000-ampere illuminated dial type "E" Westinghouse direct-current ammeters.

1 field rheostat mounting.

1 four-point voltmeter receptacle.

2 1600-ampere two-pole double-throw knife switches.

2 100-ampere, two-pole, single-throw switches for the balance coils.

There has also been installed a fourth generator panel, which at the present time is blank, being ready for mounting the instruments when the fourth unit is installed.

On each side of the generator panels is a total load panel. The one to the right when facing the switchboard, is the total lighting load panel on which is mounted the following apparatus:

2 4000-ampere, type "E," Westinghouse illuminated dial, direct-current ammeters, to indicate the entire lighting current.

2 150-volt, type "E," Westinghouse illuminated dial, direct-current voltmeters.

3 4500-ampere, single-pole, double-throw knife switches.

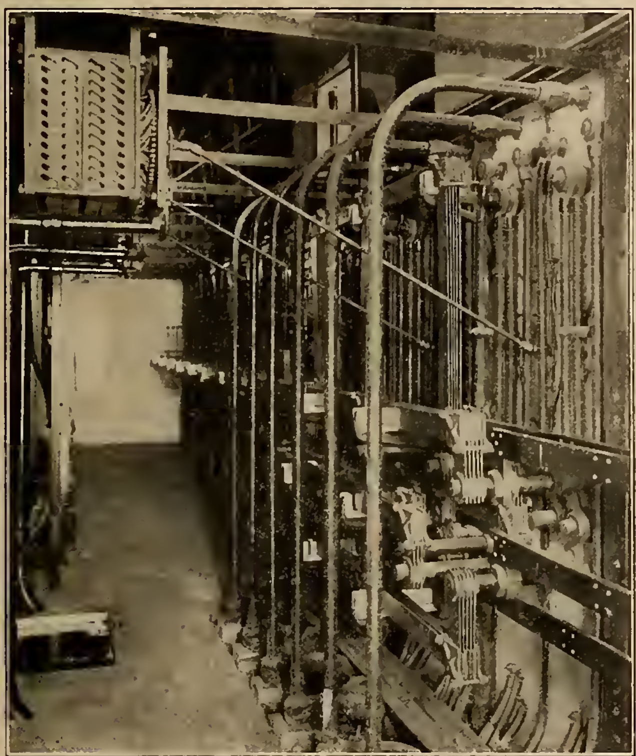
1 5000-ampere, 250-volt, three-wire, direct-current Westinghouse graphic recording wattmeter, with synchronizing attachment for attaching to the master clock circuit.

The one to the left of the generator panels is the total power load panel on which is mounted the following apparatus:

1 300-volt, type "E" illuminated dial, Westinghouse voltmeter.

1 300-0-300-volt, type "E," illuminated dial Westinghouse differential voltmeter, mounted on a swinging bracket.

1 300-volt Westinghouse illuminated dial direct-current voltmeter connectetd to the center taps of the voltmeter plug receptacle.



Back of Switchboard.

1 2000-ampere illuminated dial, type "E," Westinghouse ammeter, to indicate the entire power current.

1 six-point voltmeter receptacle.

2 four-point voltmeter plugs.

2 1600-ampere, two-pole, double throw knife switches.

1 2000-ampere, 250-volt Westinghouse, two-wire, direct-current, graphic recording wattmetetr with synchronizing attachment for attaching to the master clock circuit.

To the right of the total lighting load panel are seven lighting feeder panels. On these are placed all the switches controlling the lighting circuits throughout the building.

To the left of the total power load are two power feeder panels with switches controlling all power circuits. The two panels at the extreme left of the board are gauge panels on which are mounted 20 8½ in. dial, brass cased gauges, connected to the various apparatus in the power plant. All instruments and gauges have illuminated dials.

A 24 in. dial clock was mounted on a separate panel above the center of the switchboard. This clock together with the electric recording instruments is synchronized by the master clock.

The design of the generator panels provided for a double bus bar-system so that the lighting and power loads can be carried on separate machines. The field rheostats are mounted on the wall behind the switchboard 6 ft. above the floor and are operated from the hand wheels on the generator panels through a system of rods connected with universal joints.

Behind the switchboard is a panel on which is mounted the circuit breaker, wattmeter and fuses on the emergency service connection from the San Francisco Gas & Electric Co. All switchboard details are clearly shown by the accompanying illustrations.

Wiring.

All leads from the generators to the main switchboard are carried under the floor in ducts made by arching over trenches left in the concrete floor with thin tiles, over which the finishing surface coat of the floor was carried. From each machine 6 one million circular mil lead covered cables carry the main current to the generator panels of the switchboard.

The wiring for the lighting throughout the building is on the 3-wire 110-220 volt system with balanced load. Several two-wire 110 volt circuits are run from 2 pole double throw switches on the lighting panels for the purpose of balancing the load in case hand regulation in addition to the balancer coils is necessary.

From the panels of the main switchboard feeders run through the building to the distribution panel boards. On the typical floor there are 6 of these panel boards, one in each of the riser shafts. From these boards the individual circuits are run to the various rooms and corridor lights. A special feature in the distribution is the over-lapping of the circuits so that in general the lights in one room are supplied by more than one circuit. This is a desirable arrangement as in case a fuse blows on one circuit there will still be one or more lamps in the room on the other circuit. In actual operation this has been satisfactory.

The power wiring is on the two-wire 220-volt system. The feeders were run from the power panels of the main switch board to the various load centers of distribution in various parts of the building. On these load center panels were mounted all the fused switches and starting rheostats or controllers for all the motors to which these boards distributed current.

Leads were brought to the two outside terminals of the six point voltmeter receptacle on the total power load panel from two distribution centers of the lighting system, one on the fifth floor and one on the first floor. The center terminal of the receptacle is connected to one of the voltmeters which shows the voltage at either center of distribution when the four point plug is in the proper receptacle.

In addition to the light and power wiring a complete telephone system was installed with an instrument in every room. This system is connected through a central office in the hotel with the Pacific Telephone & Telegraph Co. system. Current for the telephone system is secured from storage batteries which are charged through a rheostat which is connected to a 110-volt circuit from the main switch board.

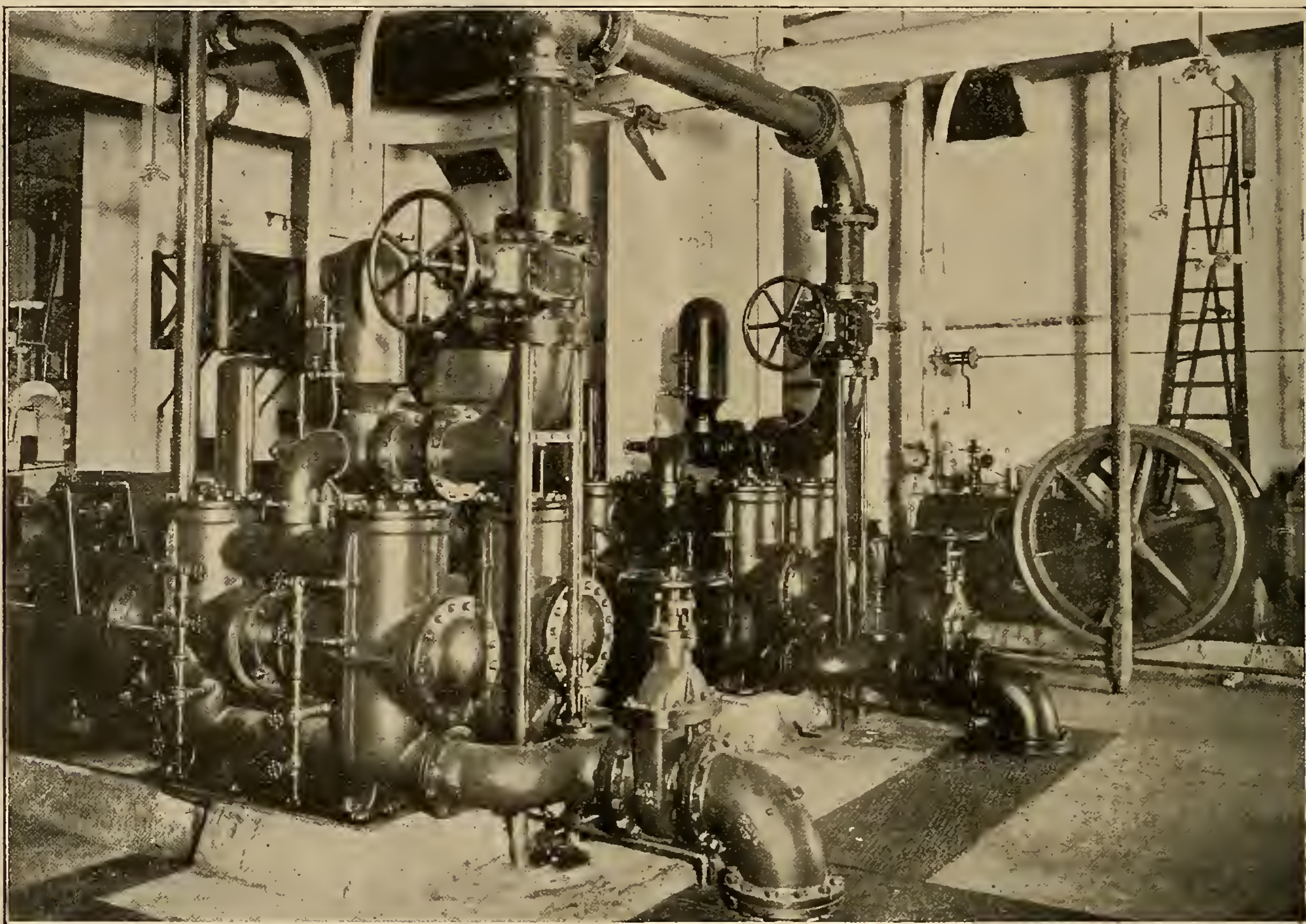
A complete call bell system with a push button in each room was installed to be used in case the telephone should be out of order. A Gamewell fire alarm system with 4 stations on each floor was installed. An alarm sent in from any station rings a large gong in the engineer's office and a small one in the chief clerk's office. From the latter bells on any of the floors may be rung. A clock system, with the master clock, synchronized hourly by the Western Union Telegraph Co. placed in the engineer's office, controls secondary clocks placed in all the public and service portions of the hotel.

The current for the bells, fire alarm system and clocks, is secured from a second set of storage batteries. These batteries are charged by a small motor generator set operating on a 110-volt circuit direct from the main switch board.

Pumps, Air Compressors, Water Supply.

To operate the hydraulic elevators three Laidlaw-Dunn-Gordon, compound, duplex, direct acting, center packed plunger pumps 12 and 18½ by 10 by 18 were installed. Two of these pumps are required to operate the elevators during the rush hours. Each pump is controlled by a Fisher pressure regulator set at 150 lb.

A Westinghouse locomotive air compressor, mounted on the side of the concrete column supporting the elevator pump discharge pipe, furnishes compressed air at 150 lb. pressure for charging the elevator pressure tanks and the air chambers on the pumps.



Elevator Pumps and Vacuum Sweeping Machine.

Two Laidlaw-Dunn-Gordon duplex direct acting center packed plunger pumps 12 in. by 8 in. by 10 in. were installed for the cold water supply. Four pressure tanks each 7 ft. 6 in. diameter by 40 ft. 0 in. long were installed. One pair of these operates under 40 lb. pressure and supplies water to the basement and first to the fifth floors inclusive, the other operates under 80 lb. and supplies the sixth to ninth floors inclusive. Both pumps are operated continuously, one on the 40 lb. sytem, the other on the 80 lb. system. Each is fitted with a Fisher pressure governor. These pumps are cross connected so that either may be operated on the high or low pressure system or one pump only can be used in which case it would operate at 80 lb. and supply the low pressure system through a reducing pressure valve.

Two 14 in. by 7½ in. by 12 in. duplex Worthington Underwriter fire pumps were installed. In order to keep these pumps in working order, they are used on the hot water system of the hotel, one on the low pressure supplying the kitchen, laundry and basement and first floor and the other on the high pressure supplying the second to ninth floors inclusive.

These pumps are equipped with pressure regulators for controlling the pumps when they are working on the house system. Each regulator has a full sized by-pass so that it can be cut out in case of fire.

Two 7½ in. by 8 in. by 9 in. crank and fly wheel air compressors were installed, each with a capacity of 72 cu. ft. of free air per minute at 100 lb. pressure.

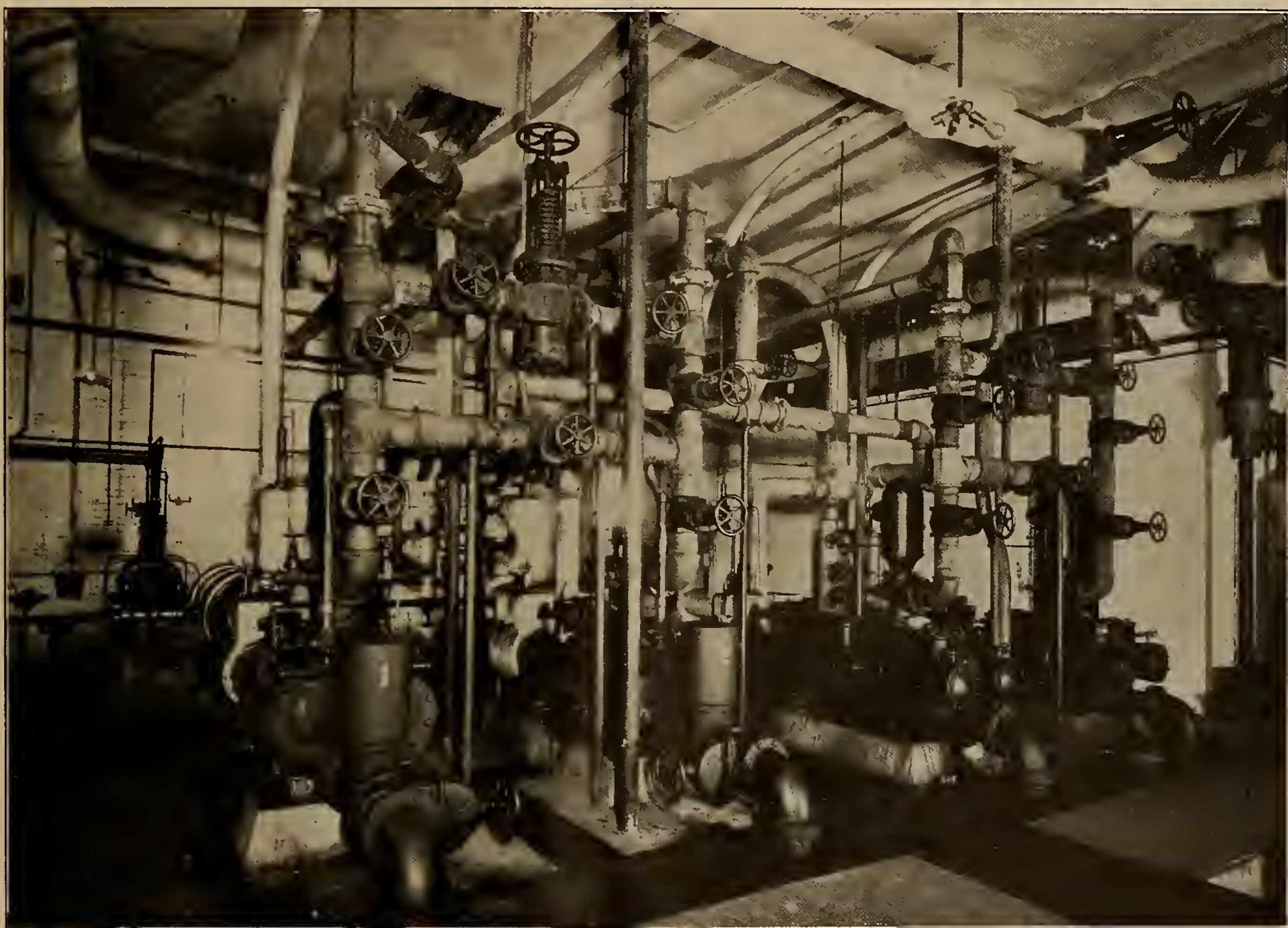
to furnish compressed air for charging the hot and cold water storage tanks, for washing the water filters, for pumping the two deep wells, and for the compressed air nozzles used for blowing dust out of the electrical machinery.

Two driven wells are sunk in the basement of the hotel, one in the ice machine room and one in the laundry. These are each 14 in. diameter, 220 ft. deep. The water level in these wells stands, when not pumping, 20 ft. below the basement. These wells are pumped by an air lift system, air being supplied to the wells at 60 lb. pressure by the above mentioned compressors.

The discharge from the air lift system is into the large brick tank located under the main court. The piping is so arranged, however, that at the time the water softener is installed the discharge will be directly into the tanks of the softening plant and after passing through the softener will go to the above mentioned court tank.

This court tank is a brick tank 100 ft. by 57 ft. by 17 ft. deep and has a capacity of 600,000 gallons. At the present time this tank is used for the storage of well water and also rain water collected on the roof. The well water, owing to its hardness, cannot be used without softening, except for flushing purposes. However, pending the installation of a water softener plant, it is being used in the hot water system of the hotel but not for boiler feed water.

In addition to this storage tank, there are two filtered water storage tanks, one located under the engineer's office and the other in the Market and New Montgomery street corner of the engine room. The first of these is 16 ft. in diameter by 9 ft. 6 in. deep with a capacity of 14,000 gallons. The second has a diameter of 10 ft. and is 8 ft. 6 in. deep with a capacity of 5000 gallons. The tops of these tanks are set at the same elevation, the bottoms being cross connected with 10 in. pipe. The house supply is drawn from these tanks and pumped to the four storage pressure tanks. By the installation of these pressure storage tanks and also all other storage tanks in the basement, it was not necessary to place any tanks on the roof, so that no water load is carried on the building columns in addition to the dead load of the building.



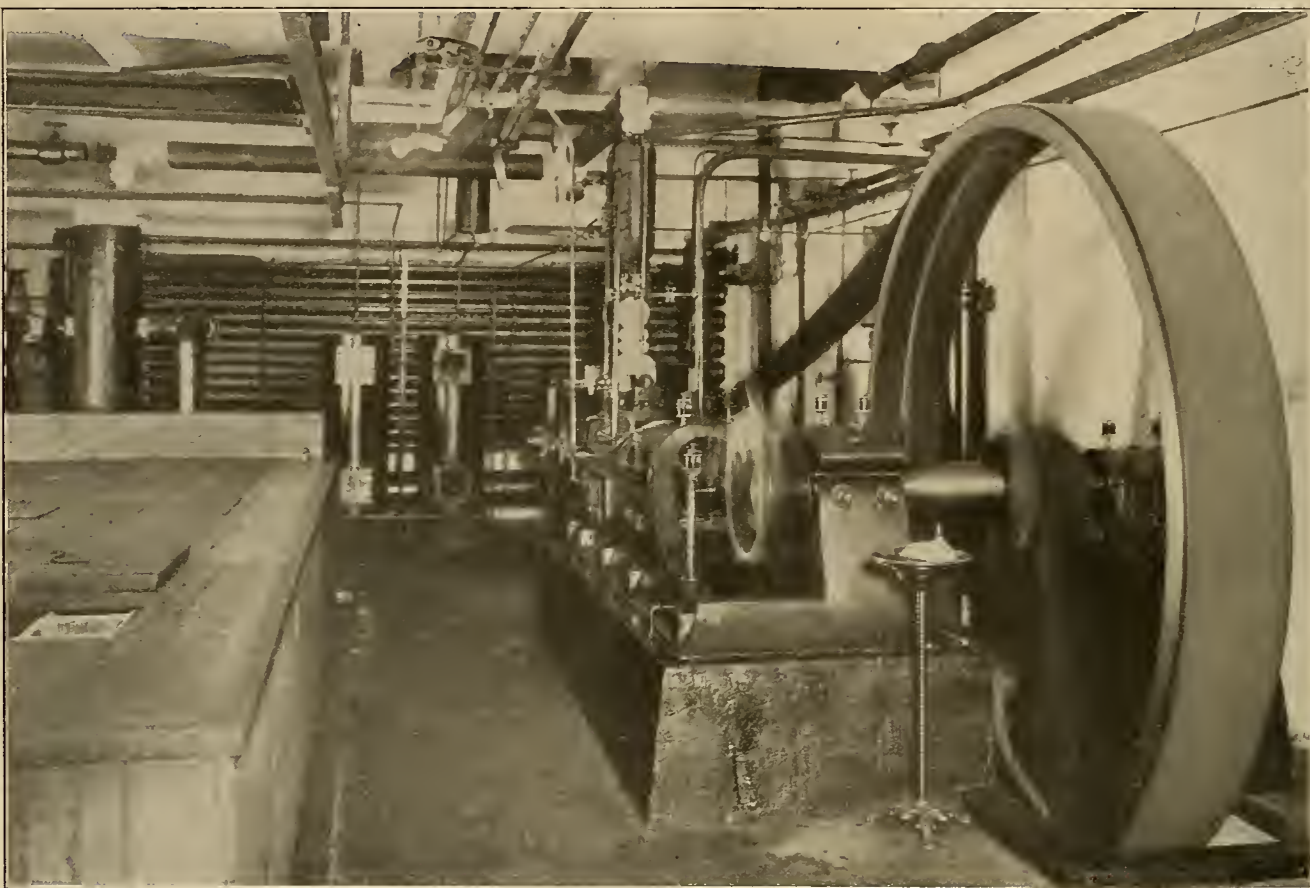
Fire and House Pumps. Air Compressors behind No. 1 Fire Pump.

On the inlet side of the house heaters and connected to the returns and the make-up of the house hot water system is a riveted steel tank 4 ft. 3 in. in diameter by 10 ft. 0 in. long with a capacity of 1060 gallons. This acts as a storage reservoir for hot water and is also a mixing tank for the hot water make-up.

Two Goubert vertical closed hot water heaters are used for heating the water supplied to the house; one of these furnishes a supply to the basement, kitchen and laundry and has a capacity of 100 gallons per minute from 60 degrees to 200 degrees plus; the other has a capacity of 200 gallons per minute from 60 to 190 degrees. These are supplied with exhaust

steam from the exhaust loop running around the basement. The steam connection to each is fitted with a Johnson thermostatic valve controlled by a hot water thermostat in the hot water discharge of each heater. These thermostatic controls were installed in order to control the temperature of the water and prevent it from becoming so hot as to damage the plumbing fixtures.

Two open gravity rapid sand filters were installed in the filter room under the Market street sidewalk. The filter tanks are reinforced concrete each 7 ft. 10 in. by 10 ft. 0 in. Each filter was designed to filter a maximum of 226,000 gallons every 24 hours, which is at the rate of 125,000,000 gallons per acre per day, or 2880 gallons per sq. ft. per day. The water supplied to the hotel is taken from the Spring Valley main on New Montgomery street, passes through a battery of eight 2 in. Neptune meters, thence through a 6 in. Venturi meter to the filters. From these it is discharged into the open, filtered water tanks mentioned above.



Refrigerating Plant.

This Venturi meter is equipped with a Type "M" combined indicator and chart recorder which gives a graphic record of the rates of flow through the meter. By adjusting the valves on the supply pipe any rate of flow can be maintained so that the filters will work at a uniform rate. As the consumption of water throughout the house varies the open filtered water storage tanks serve as equalizing reservoirs.

The filters were installed by the Continental Jewel Filtration Co. and are equipped with their patent strainers. The effluent pipe is fitted with an automatic float valve closing off the filters in case the filtered water storage tanks should be full. These filters are equipped with continental Jewel air washing system, compressed air being furnished through a reducing valve from the two compressors at 4 lb. pressure. On account of the location of the filters below the sewers, the wash water of these tanks is piped to the 7 in. centrifugal circulating pump, which lifts the wash water into the large sewer on Market street.

Plans have been prepared for a water softener plant to be located in the New Montgomery street end of the engine room. This is to be arranged so that the overflow will pass directly into the court tank, which will then be a softened water reservoir from which boiler feed water and hot water house supply will be taken.

Refrigeration and Ice Making.

The ice making and refrigerating plant is in a special room and includes one 35-ton horizontal double acting Vulcan motor driven ammonia compressor, double pipe ammonia condensers, ammonia system complete, 6-ton ice making and cooling tank, etc. The brine is circulated through the room coils by two steam brine circulating pumps.

There was also installed machines for preparing the ice for various departments, including saws for making cubes for drinking water, ice crusher and ice shaver. These machines are all driven from a jack shaft by a 3 h.p. motor.

There are thirty six different cold storage rooms and refrigerators placed in various parts of the basement, kitchen and bar room to suit the convenience of

the various departments. There are also three ice storage rooms, having a capacity of 50 tons.

The construction of these rooms in general includes sheet cork insulation, tile walls and floors, plastered ceilings, oak doors and trimmings, bronze nickel plated hardware throughout, and galvanized iron shelves, racks and drawers. The designs were carefully worked out so as to include as little wood as possible, in order to secure a durable and sanitary construction.

The rooms and refrigerators are cooled by circulating cold brine through coils of galvanized pipe arranged in coil lofts. Each room is provided with a separate regulator so that the temperature may be varied to suit special conditions.

The ammonia compressor is driven by a 50 h.p. variable speed motor, with a speed variation from 225 to 450 r.p.m. This wide variation of speed requires that the motor have interpoles or commutating poles, in order to furnish satisfactory operation over the whole range of speed. The motor is also compound wound in order to give the heavy starting torque required at starting the compressor.

In order to prevent excessive pressure on the ammonia system a special controller was installed on the motor control panel. This consists of a Cutler-Hammer solenoid switch, the magnetizing current of which passes through a pair of contacts which are held in place by a spring latch. Excessive pressure will release this latch through the action of a special Vulcan diaphragm controller, thus interrupting the magnetizing current, releasing the solenoid switch and stopping the motor. On account of the size of the machine, it was not equipped with an automatic starter in case the pressure should run down, as it was desired that the attendant ascertain the cause of the excessive pressure before the machine could be again started.

Vacuum Sweeper.

A complete vacuum sweeping and scrubbing system was installed with outlets on all floors. The vacuum pump is located in the main engine room near the elevator and fire pumps. It is a Vacuum Engineering Company machine and has a capacity for operating eight sweeping nozzles at one time. On the first floor and basement provision is made so that the scrubbing water may be supplied through the hose and implements and by reversing a valve the water may be drawn back through this system and discharged into the sewer. This system operates without separating tanks of any kind and all dirt is discharged automatically to the sewer.

Heating and Ventilating.

The upper floors of the hotel are heated by direct radiation, steam being circulated by the Wade vacuum system. Under each window is placed a radiator enclosed in a galvanized iron lined recess under the window sill. A large bronze grill was placed in the baseboard and another in the window sill to allow the air to circulate across the radiator. A removable panel the same size as the recess allows access to radiator for cleaning and adjusting. The steam supply to the radiators is controlled by valves having extra long stems passing through the casing with the hand wheel outside.

Exhaust steam is carried to the pent house floor by two 7 in. risers and one 8 in. riser, which connect to a large main running entirely around the building in a pipe space immediately under the roof. Drop lines from this main supply steam to the radiators on all floors. These drop lines are anchored at the fifth floor. Returns parallel the steam lines, being connected to the radiators through Wade vacuum valves. The lower ends of all steam lines are drained through vacuum valves.

The space between the skylights over the main court, the ladies' dining room, the concert room, the bar, the barber shop, and over the corridors was fitted with steam coils automatically controlled by thermostats located in the rooms beneath for the purpose of keeping the space between the skylights at an even temperature and preventing down drafts from the cold glass during cloudy days or at night.

In the engine room are two 6 in. by 10 in. by 12 in. Marsh direct acting steam vacuum pumps. All returns are brought to a Wade condenser with a water jet for cooling. The suction of each vacuum pump is connected to this condenser from which the condensed water and air is pumped and discharged into the hot well. These pumps are designed so that either pump can maintain from 5 in. to 10 in. vacuum on the entire heating system.

The basement and first floor, containing all the public rooms, are heated by the indirect system with the addition of a few direct radiators under the windows in the stores on Market and New Montgomery streets and also in the vestibules at the various entrances.

The main fresh air fan room is in the basement and contains the four fans supplying fresh air to the engine room, the men's grill, the bar and the barber shop, the north half of the main court, the ladies' dining room, the south half of the main court and various public offices, the help's kitchen, laundry and other service portions of the basement.

Fresh air is brought into this room by two shafts each 7 ft. by 12 ft., taking the fresh air from the space above the main court. Across the bottom of each of these shafts is an air washer, the one on the north side having a capacity to wash 53,000 cu. ft. of air per minute, and the one on the south side having a capacity to wash 46,000 cu. ft. per minute. These washers are equipped with spray nozzles, water being supplied by two motor driven centrifugal pumps. The air passes through the water screens and then through a series of eliminators which remove all suspended moisture. The outlets of the air washers are directly connected to the inlets of the fans, the tempering coils being set in these ducts.

In another fan room in the basement are three exhaust fans, one exhausting the engine room, the second exhausting the men's grill, bar and barber shop and the third the laundry.

In a third fan room is the exhaust fan exhausting the pastry, bakery, butcher shop and other service portions of the basement.

On the mezzanine floor in a separate room is the exhaust fan which exhausts the air from under the kitchen hood and also from under the hood of the grill

in the men's dining room. The discharge of this fan is especially heavy riveted iron duct in the main stack compartment 24 in. by 36 in. running to the roof. The duct from the main kitchen hood is heavy riveted iron No. 10 gauge, covered with asbestos. This fan is by-passed, the by-pass damper being held closed by a fusible link. In case the grease should burn in the duct, this by-pass will open and a damper on the fan inlet close, allowing the hot burning gases to pass directly up the discharge duct to the roof, without passing through the fan.

In a second fan room on the mezzanine floor, is the main kitchen exhaust fan, and the fan for exhausting the concert and reception rooms.

In a third room on the mezzanine floor, is the main kitchen supply fan; also the supply fan for the concert and reception rooms along the Jessie street side of the hotel. The exhaust and supply fans for the banquet and ball room are also placed in this fan room. The fresh air shaft taking the air from the space above the main court is in the south end of this room. Across the end of this is another air washer complete with nozzles and eliminator plates. The fresh air fans in this room are not directly connected to the outlet of the air washer but the entire room is used as a washed air chamber. Each fresh air fan in this room is fitted on its inlet side with heater coils.

In five fan rooms on the pent house floor are located the exhaust fans which exhaust the bath rooms. One of these fans is also connected to the hood in the helps kitchen in the basement. All of these pent house fans discharge the foul air through louvered openings in the roof.

All fans are direct connected to Westinghouse slow speed motors of the size and speed shown on the following table; which also shows the size and capacity of all fans.

PALACE HOTEL FANS.

Rooms Supplied	cu. ft. per min	No. of housing in.	Dia. of wheel	R. P. M.	H. P. of Motor
Service part of basement	20,000	110	66	240	6¼
Ladies' dining room, court, offices	26,000	110	66	240	9
Men's grill, court, bar room, barber shop	25,000	110	66	240	9
Engine and boiler room	28,000	120	72	220	10
Banquet room	17,000	100	60	265	6
Concert room, reception rooms	15,000	100	60	265	5
Kitchen and pantries	16,000	100	60	265	5
Rooms Exhausted					
Service part of basement	18,000	110	66	240	6
Ladies dining room, court, grill, bar, barber, offices	45,000	140	90	180	15
Laundry	11,000	90	54	290	4
Engine and boiler room	28,000	120	72	220	10½
Banquet room	21,000	110	66	240	6½
Concert and reception rooms	17,000	100	60	265	6
Kitchen and pantries	20,000	100	60	290	6
Kitchen hood	12,000	70	42	550	10
Bath rooms and helps' kitchen	21,000	110	66	240	6¼
Bath rooms	14,000	80	48	330	4½
Bath rooms	12,000	80	48	330	4
Bath rooms	8,000	60	36	440	2½
Bath rooms	15,000	100	60	265	5

All fans are American Blower Co.'s fans with full steel housing. All motors are equipped with Cutler-Hammer speed controllers of the fan type with speed regulation of 100 per cent to 50 per cent of full speed.

All temperature control is by thermostatic valves on the steam inlet to the heater coils. These are operated by thermostats placed in the various rooms supplied by the fans.

All duct systems throughout the building are single duct as, on account of the large area of the building the large size of rooms and the large amount of air required, the cost of a double duct system would have been prohibitive.

In general, the fresh air is admitted to the room about 12 ft above the floor line. In the two grill rooms fresh air registers are located over the doors. The fresh air inlets on the Annie and Jessie street side of the ballroom are long narrow ones built in the sides of the window casings, the warm air blowing out across the windows to prevent cold drafts from the large glass surfaces. On the inside wall of the ballroom the fresh air is brought in over the doors. As smoking is allowed in all of these rooms, the exhaust registers were made long and narrow, running from a point about 30 in. above the floor to a point 12 ft. above the floor, in order to clear the room of smoke without drawing it down to the floor line. In actual practice this long exhaust register works very satisfactorily.

The amount of air exhausted from the main court is much less than the supply, while that of the two grill rooms on each side of the court is much greater than the supply. By this distribution the exhaust fans draw air into the grill rooms from the main court, thus preventing any odors from getting into the court and lobby.

The main kitchen supplies are brought in through down spouts directly over the space between the serving table and the front of the ranges. Fresh air inlets were also provided along the north wall of the kitchen. The main exhaust from the kitchen is taken out under the hood over the range and through exhaust outlets placed in the ceiling. The kitchen exhaust is 100 per cent in excess of the supply. This proportion insures that no odors from the kitchen will reach the grill rooms or the main court which connect to the kitchen through the serving pantries. The air in the kitchen and pantries is changed every 2½ minutes. In the actual operation of the kitchen the tendency of all serving doors is to swing open toward the kitchen.

The hood over the grill in the men's grill room is connected to the kitchen hood exhaust fan. An additional exhaust duct is run from the space directly over this to the main stack compartment. As the temperature of this stack compartment is at all times greatly in excess of the room temperature, the whole stack compartment acts as a natural draft exhaust.

In order to keep the floor of the grill, bar and barber shop cool two false ceilings were built over the engine and boiler room which occupy the basement directly under the above named rooms. Between these ceilings is in an air space varying in height from 18 inches to four feet. The main cold air supply duct to the engine and boiler room runs in this space over one edge of the engine room and furnishes air to the room through openings in the ceiling directly over the generators and the pumping equipment. Outlets from this duct were left into the space between the two ceilings to furnish a constant supply of cold air to this space. The exhaust duct for the engine and boiler room runs along the room on the opposite side from the supply duct and exhausts the hot air from directly over the rear end of the boilers. Openings are also

provided into this duct for exhausting the air from the space between the ceilings. Thus cold air is admitted to this space on one side of the room and is circulated across the room to the opposite side and exhausted. This constant circulation of cold air has proved very effective in keeping the floor above the boilers cool. This space also acts as a deadener, preventing the noise of the oil burners and machinery from reaching the rooms above. All electrical conduits ventilating ducts, heating and plumbing pipes were run between the two ceilings. All power plant piping is below both ceilings for convenience in reaching the valves.

The exhaust register for each bathroom is placed in the center of the ceiling. A bronze grill was placed in the bottom of the door connecting the sleeping room with the bathroom to allow air to pass from the room to the bathroom. The bathroom system is proportioned to change the air once every five minutes in each bathroom. As all sleeping rooms are nearly of the same size, this rate for the bathroom corresponds to a change of air in the bedroom once every 30 minutes.

All branch ducts from the bathrooms are connected into a large duct running in the furred ceiling over the corridors, these ducts being connected to vertical ones in the five shafts, which run to the pent house. Over the top of each of these shafts is placed a full housing steel plate fan with discharge through a louvered opening above the roof. Each bathroom connection is equipped with a sliding damper which was set before the register faces were placed, so as to insure an equal distribution of the air through all the branches.

All of the branches of the fresh air ducts are also equipped with adjustable dampers which were set so that all air outlets receive their proper proportion of the total amount of air carried by the main duct. Behind the register faces of all fresh air and exhaust outlets a series of baffle plates were installed to insure an even distribution of air over the entire register face. In public rooms of the building the register faces are composed of ornamental iron or plaster behind which are placed brass screens of ¼ in. mesh. All register faces were of special design to conform to the scheme of the interior decorations.

All fresh air ducts carrying heated air are covered with a one-inch covering of asbestos wrapped with canvas.

The specifications for the ventilating work called for fans capable of delivering the quantities of air specified in the above table. A series of tests were made on each and every fan to determine whether the fans were delivering the specified amount of air. During these tests the air delivered by the fan was measured with a Pitot tube inserted in the inlet or discharge connection to the fan, depending on whether a supply or exhaust fan was being tested. These tests showed that all fans were delivering the amount of air required and in most cases much more than that specified.

To insure silent operation of all motors and fans which were placed directly on the floor slab of the mezzanine and pent house floors a layer of one inch sheet cork was inserted between the fan base and the floor. The connections to the inlet and outlet of all fans were made by flexible joints of heavy canvas, reinforced with light screen, to prevent vibration from being communicated to the ducts.

Elevators.

The elevator equipment of the building consists of five passenger elevators running from the first floor to the eighth; one service elevator running from the basement to the eighth; two service elevators running from the basement to the ninth floor; also two lifts, one from the basement to the sidewalk and one from the basement to the kitchen. The passenger elevators are geared for a speed of 400 ft. per minute and the service for 350. These eight machines are rope driven of the horizontal type, the machinery being located in the basement. The two short rise elevators are of the plunger type. The passenger elevators are all equipped with automatic air operated doors. All elevator equipment except the pumps was installed by the Otis Elevator Co. of New York and San Francisco.

The architects for the building were Trowbridge & Livingston of New York. All of the plans were drawn in their San Francisco office under the direction of Mr. Geo. W. Kelham, a member of the firm.

The entire mechanical equipment of the hotel was designed by Hunter & Hudson, consulting engineers, San Francisco, Cal., and was installed under their supervision.

CONDENSED DATA OF PALACE HOTEL EQUIPMENT

Apparatus.	Make.	Contractor.
Boilers	Babcock & Wilcox.	C. C. Moore & Co.
Engines	McIntosh & Seymour.	C. C. Moore & Co.
Power Plant Piping		C. C. Moore & Co.
Stack and Breeching		C. C. Moore & Co.
Generators and Motors	Westinghouse.	Westinghouse E. & M. Co.
Switchboard		J. G. Sutton Co.
Electric Wiring, Telephone Wiring		J. G. Sutton Co.
Clock, Bell and Fire Alarm Systems		J. G. Sutton Co.
Condenser Equipment and Cooling Tower	Wheeler.	C. H. Wheeler Mfg. Co.
Elevator and House Pumps	Laidlaw-Dunn-Gordon.	H. R. Worthington Co.
Fire Pumps	Worthington.	H. R. Worthington Co.
Ventilating Fans	American Blower Co.	A. B. Co.
Indirect Heating and Ventilating		Robt. Dalziel Jr. Co.
Direct Heating	Wade.	Mangrum & Otter, Inc.
Air Compressors and Air Lift	Compressed Air Machine Co.	Compressed Air Machine Co.
Water Filters	N. Y. Continental Jewell.	Cal. Jewell Filter Co.
Refrigerating Plant	Vulcan.	Vulcan Iron Works.
Sump and Blow-Off Tanks, Oil Tanks		Risdon Iron Works.
Elevators	Otis.	Otis Elevator Co.

NEW ELECTRICAL DEFINITIONS.

The Standards Committee of the American Institute of Electrical Engineers has submitted a number of proposed amendments to the Standardization Rules of the Institute. Many of these amendments involve slight changes in the wording of present definitions, the following list being that of the more important additions.

A Compensated Alternator is an alternator which automatically compensates for the drop in voltage in its armature, or in its armature and the line.

A Synchronous Compensator is a synchronous machine, running either idle or under load, whose full excitation may be varied so as to modify the power-factor of the circuit, or through such modification, to influence the voltage of the circuit.

An Inductor Alternator is an alternating-current generator in whose armature windings the field magnetic flux pulsates but never reverses.

An Induction Generator is a machine similar to an induction motor but driven as an alternating-current generator.

A Rotor is a rotating member of a machine.

A Stator is a stationary member of a machine.

Equalizing Rings are rings connected to equipotential points of multiple-wound armatures to equalize the voltage between brushes.

A Primary Winding is that winding of an induction motor or of a transformer which receives power from an external source.

A Secondary Winding is that winding of an induction motor or of a transformer which receives power from the primary by induction.

Note: The terms "High-tension winding" and "Low-tension winding" are suitable for distinguishing between the windings of a transformer where the relations of the apparatus to the source of power are not involved.

A Transformer-Balancer is an auto-transformer for dividing a voltage in constant proportions, and usually into two equal portions.

An Induction Starter is a device used in starting induction motors, converters, etc., when they are started by voltage control, consisting of an auto-transformer in connection with a suitable switching device.

A Leakage Reactance is that portion of the reactance of any induction apparatus which is due to stray flux.

A Synchronoscope is a synchronizing device which, in addition to indicating synchronism, shows whether the machine to be synchronized is fast or slow.

A Voltmeter Compensator is a device used in connection with a voltmeter to reduce its reading by the amount of the line drop, and thus causing it to indicate the voltage delivered at the distant end, or at any other predetermined point of the line.

A Watthour Meter is an instrument for registering total watthours. This term is to be preferred to the term "integrating wattmeter."

Recording Wattmeters
Recording Voltmeters
Recording Ammeters

are instruments which record upon a time-chart the values of the quantities they measure.

b. Indicating Meters should be rated according to their full-scale reading of volts, amperes, or watts (at unity power-factor in wattmeters).

c. Watthour Meters should be rated by their power delivery at rated volts and amperes at unity power-factor.

CHANGES MADE IN THE AREAS OF CALIFORNIA NATIONAL FORESTS.

The President signed proclamations effective July 1, 1910, eliminating 65,490 acres from, and adding 9,389 acres to, the Sequoia National Forest, California, transferring 175,730 acres from the Sierra National Forest to the Sequoia, and establishing the Kern National Forest by the division of the Sequoia. The areas excluded by the Sequoia proclamation are scattered along the west boundary of the Forest and are lands which, upon a very careful examination made by the Secretary of Agriculture last summer, were found to be not chiefly valuable for National Forest purposes. They comprise areas lying north and east of Squaw Valley, southeast of Aukland, northeast of Lemon Cove, and west of White river.

The additions to the Sequoia are located along the western boundary and consist of scattered tracts which were found to be best adapted to forest uses and watershed protection. The main areas added lie northwest of Milo and northeast of Daunt.

The area transferred from the Sierra to the Sequoia comprises that portion of the watershed of the South Fork of Kings river which lies north of the river. The entire watershed of the South Fork of Kings river is thus now within the Sequoia Forest. The area of the reduced Sequoia Forest is approximately 1,261,043 acres, and that of the Sierra approximately 1,759,950 acres.

The new unit to be known as the Kern National Forest has an area of approximately 1,951,191 acres and comprises that portion of the old Sequoia Forest lying east of Kern river and south of the north boundary of Kern county. The headquarters of the new Forest will be located at Bakersfield. The unappropriated portions of the areas eliminated by this proclamation will be restored to settlement and entry after having been advertised in the local papers by the Secretary of the Interior.

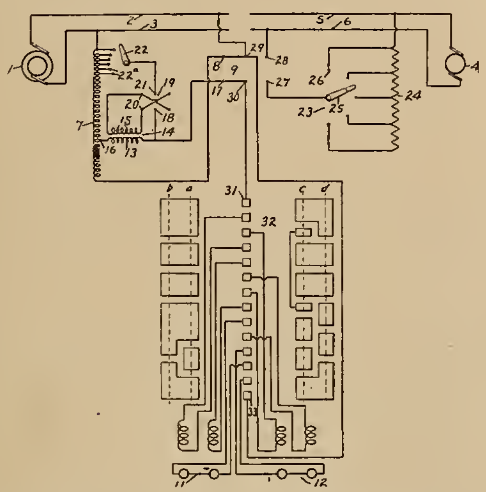
BOOKS RECEIVED.

Miscellaneous Tests of Electric Car Equipment. By Eugene C. Parham and John C. Shedd; 153 pages; 5x7½ inches; 73 line cuts. McGraw-Hill Book Co., New York, and Technical Book Shop, San Francisco. Price, $1.00.

The present volume is the second of two, the first being entitled "Shop Tests on Electric Car Equipments." The second volume supplement contains directions for both stationary and motion tests. Rules are given for testing car fuses, circuit breakers and controllers. A number of miscellaneous tests, such as speed, acceleration, retardation and horse power required are presented. The concluding chapter gives illustrated directions for reviving shocked persons and relieving burns. To anyone engaged in work of this character this book is invaluable.

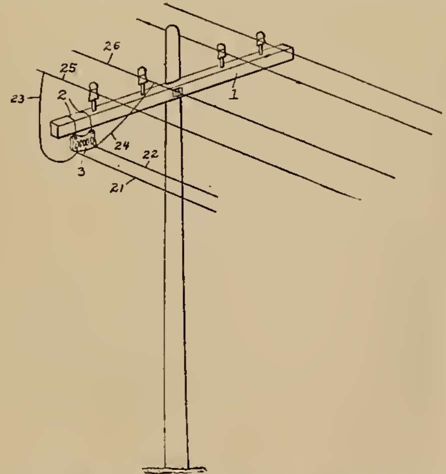
PATENTS

964,658. Method of Operating Electric Motors. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania. The method of operating electric motors having armature and field magnet windings which consists in supplying alternating currents to the motors so that only a portion of the total amount of current traverses each of the field magnet windings, and the total amount traverses the armature windings



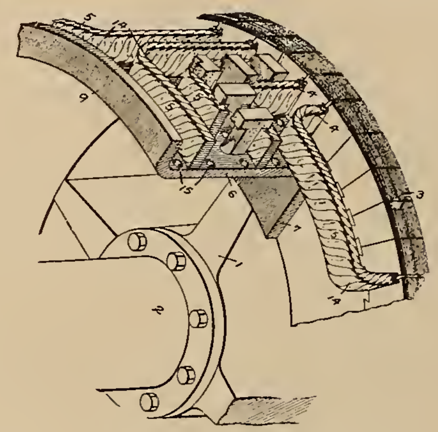
for the lower speeds, then in supplying the current so that only a portion of the total amount traverses each of the armature windings for the higher speeds, and in supplying direct current to the motors so that the total amount of current traverses the field magnet and armature windings for the lower speeds and only a portion of the total amount traverses each of the windings for the higher speeds.

964,737. Insulated Distributer for Electric Service-Wires. John B. Ashley, Seattle, Wash. In a wire distributing support, an insulating casing entirely surrounding the support,



a plurality of divisions carried by the casing and the support and adapted to receive a plurality of wires, and means engaging the casing surrounding the support and adapted to support both the casing and the support.

964,630. Dynamo-Electric Machine. Joseph P. Feeney, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York. In a dynamo electric machine, a rotatable member, coils therefor having end turns or connections, a support for said end turns, and means for holding each of said end turns in place against centrifugal force comprising a plurality of members arranged in a row, each of said members having one or more flanged portions, each of

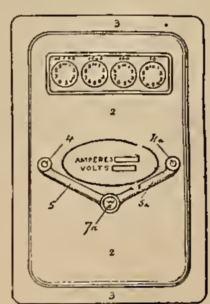


said flanged portions engaging the exterior surface of a single end turn, and a single stem portion passing between the end turns and secured to said support, said members being spaced apart about said support.

964,963. High-Pressure Turbine-Pump. Walter L. Forward, West Berkeley, Cal., assignor to Byron Jackson Iron Works, West Berkeley, Cal. In combination with a turbine pump, the guide vanes forming fluid passages therein and

having outwardly projecting segments, of shells and covers having corresponding annular grooves into which the segment project, said grooves being undercut and having depressed pockets at intervals, and a filling of fusible packing metal cast into the grooves around the segments.

964,681. Meter-Lock. Isaac W. Norcross, New York, N. Y. In a meter lock, a fixed base having a removable incasement with threaded studs projecting from said base and through



said incasement, in combination with adjustable lock arms engaging said projecting studs and having interlocking ends with openings to admit a soft metal seal at an intermediate central point.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

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604 Mission Street, San Francisco

EASTERN OFFICE. 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE. 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
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Single Copies, Current Month	each	.10
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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
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CONTENTS

The next issue of the Journal of Electricity, Power and Gas, August 6, will contain a complete illustrated description of the system of the Northern California Power Co., written by Rudolph W. Van Norden.

The Power of Money

We often speak figuratively of the power of money without a full appreciation of the literal aptness of this expression. Adopting the hydraulic analogy, the stream of coin that is poured forth each year from the mints may well be likened to a stream of water fed from the clouds. Both run to waste unless properly conserved and controlled so as to perform useful work. Whether stored in mountain reservoirs or in bank vaults, their energy is but potential until the gates have been opened and these quantities are set in motion by some such force as the attraction of gravitation or of interest. It may seem novel to think of interest as a force, but in the power equation of money it is invaluable. It is much like gravity, in that its effect is greatly accelerated when compounded. Conducted through the proper channels, it is money that keeps the wheels of industry in motion, and so in time money thus becomes power.

Judging from the press dispatches of this week, the supply has been shut off from the pipe lines leading to the stock and bond market. Divers reasons are assigned for the undeniable evidence that many good securities are a drug on the market. Stocks that will pay six or seven per cent on the present investment move but slowly. Such sluggishness may partly be accounted for by the lack of confidence engendered by legislation which threatens to depreciate the value of the property belonging to the "special interests," who by the way are largely made up of those thrifty individuals throughout the country who seek investment for their savings. This support of the great investing public has been withdrawn and the professional buyers are not strong enough to hold up the weakening market. This icy barrier of distrust has been congealed by the political promises of further anti-trust laws, and until melted by the warming rays of renewed confidence, the stored money of the small investor will be withheld. It is difficult to induce a man to put his savings into a proposed hydroelectric development on government land for whose use the power company has to pay a tax so high as to make it impossible for water generated power to compete with the cheap steam power now available.

These uncertainties are, however, but contributory factors in causing a money drought. This stream has also been greatly reduced by "the high cost of living." which has been more accurately stated "the cost of high living." We also read in the daily papers that millions of dollars are being spent for automobiles, which are not only a means of diversion for the owners but also one of the causes of the diversion of money flow. With the tremendous reserves now being carried in the savings banks and held in the safe deposit vaults, it can be but a matter of time before this money will inundate the market, when the price of stocks and bonds will reach a new high water mark. The sage advice is to buy now while they are at low ebb.

PERSONALS.

F. W. Jenifer, a telephone official of Los Angeles, is visiting San Francisco.

W. E. Bennett, an electrical engineer of New York, is a San Francisco visitor.

H. M. Bacon, of the San Francisco office of Ford, Bacon & Davis, is at Los Angeles.

James H. Wise, hydraulic engineer with F. G. Baum & Co. of San Francisco, is in Alaska.

W. P. Hammon recently returned to his San Francisco office after an extensive Eastern trip.

William D. Ward, of the Pelton Water Wheel Company's sales department, is in Southern California.

Marshall W. Gleason of the Gleason, Tievout Company of Brooklyn, N. Y., is visiting the Pacific Coast.

Thomas Mirk, of Hunt, Mirk & Co. of San Francisco, has returned from a business trip to Puget Sound.

Sidney Sprout, electrical engineer, has returned to his San Francisco office after visiting Oxnard, Cal.

E. J. Kendall, of Ukiah, superintendent of the Snow Mountain Power Company's system visited San Francisco last week.

Tracy E. Bibbins, assistant Pacific Coast manager of the General Electric Company, recently returned from an Eastern trip.

Walter M. Fagan, manager of the Los Angeles offices of the National Conduit and Cable Co., was at San Francisco this week.

W. S. Heger, Pacific Coast district manager for the Allis-Chalmers Company, visited his Los Angeles office during the past week.

E. C. Johnson has been appointed engineer in charge of maintenance of way and construction of roadway and buildings for the Pacific Railway at Santa Monica.

W. W. Briggs, Pacific Coast district manager of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from an outing in the mountains.

C. O. G. Miller, president of the Pacific Lighting Company, of Los Angeles, has returned to his home at San Francisco after a summer vacation spent in automobiling in Southern California.

C. A. Coolidge has been appointed general manager of the Oregon Electric Railway, Portland, Ore., to succeed Mr. Guy W. Talbot, who resigned to become president of the Portland Gas & Coke Company, Portland, Ore.

H. L. Kirker, an engineer with the railway and lighting department of the Westinghouse Electric and Manufacturing Company, recently arrived from Pittsburg and spent a few days at the company's San Francisco office.

E. M. Frazer, inventor of the Frazer electric elevator system, which was purchased by the Otis Elevator Company several years ago, has returned to his home at Yonkers, N. Y., after spending several months at San Francisco.

J. B. Coggins, manager of the Postal Telegraph Company's Denver office, has been assigned to take charge of the company's San Francisco business. Mr. Coggins has advanced steadily since his start with the company as messenger boy.

G. W. Slocum, the engineer of the Portland Railway, Light & Power Company, has returned to Portland after spending a week at San Francisco. He was at one time in charge of the North Beach plant of the United Railroads of San Francisco.

Wynn Meredith, Pacific Coast manager for Sanderson & Porter of New York, is expected at his San Francisco headquarters about August 3, after spending the past month in British Columbia, principally in connection with the installation of the Jordan river development.

Chas. F. Stamps, Jr., 631 South Hill St., Los Angeles, has been appointed novelty editor of the Pacific Coast Gas Association, vice G. H. Hollidge, resigned.

George S. Binckley, who has been connected with the British Columbia Electric Railway Company Ltd., as consulting engineer and chief hydraulic engineer for nearly two years past, expects to conclude his work in British Columbia in September, and resume his consulting practice in Los Angeles.

J. F. Adams, for some time Reno manager for the Pacific Telephone and Telegraph Company, has resigned his position to take charge of the Nevada-California-Oregon Telephone and Telegraph Company in the position of general manager. He has been succeeded by E. H. Heffernan of Sacramento, Cal., who has been in the service of the company for a number of years as district manager.

R. A. Philips, an engineer connected with Stone & Webster, of Boston, has arrived at San Francisco. It is understood that he is here in connection with the taking over of the operation of W. P. Hammon's electric power plants at Reno and elsewhere on the Truckee River by his firm. The Hammon interests will still hold the control, but Stone & Webster will improve and operate the system.

H. H. Noble, president of the Northern California Power Co., took a large party of electrical men, capitalists and engineers to Heroult, Shasta County, last week to inspect the operations of the Noble Electric Steel Co.'s electric iron smelter. The furnace was tapped every six hours and the output has been from 16 to 20 tons daily. Among those in the party were: Edward O'Neill, professor of chemistry, University of California; Richard B. Carr, Carnegie Steel Co.; C. B. Morgan, secretary, Noble Electric Steel Co.; C. R. Downs, Amador Water and Light Co.; G. K. Weeks, of N. W. Halsey & Co., and S. T. Wellman, chairman of the Wellman-Seaver-Morgan Co., of Cleveland, O. An additional furnace will be built at once.

JOBBERS' MEETING.

A meeting of the Pacific Coast Jobbers' Association will be held at Del Monte, California, August 5, 6 and 7.

TRADE NOTES.

The Oahu Railway and Land Co., of Honolulu, has purchased from the General Electric Co. two additional C. C. 2, 7 kw., 5,000 r.p.m., 125 volts d.c. non-condensing Curtis steam turbines. It is supposed that they will be used for train lighting purposes.

The General Electric Company reports the following sale to the San Diego Consolidated Gas and Electric Co. (H. M. Byllesby & Co., engineers): One A. T. B. 4, 2,000 kw., 1,800 r.p.m., 2,300 volts, horizontal condensing Curtis steam turbine. The company has already installed a smaller vertical steam turbine.

It is an interesting fact, perhaps not generally known by operating telephone men, that precious metals such as platinum, gold and silver, and even precious stones such as diamonds, are used extensively in the manufacture of telephone apparatus. The Western Electric Company, the largest manufacturer of telephones in the world, uses upwards of one ton of platinum each year.

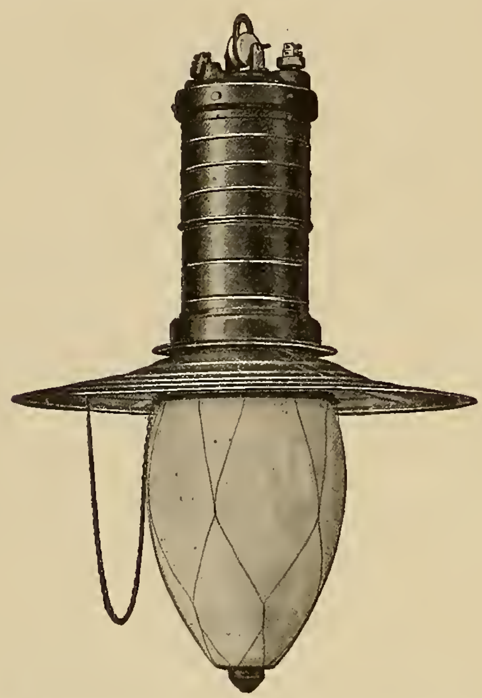
NEW CATALOGUES.

The July number of "The J.-M. Packing Expert," from H. W. Johns-Manville Company, contains announcement of the new J.-M. metallic packing and also of J.-M. asbestos non-burn brake band lining.

INDUSTRIAL

VERTICAL CARBON FLAME ARC LAMP FOR D. C. SERIES, MULTIPLE AND MULTIPLE SERIES SERVICE.

The remarkable efficiency, pleasing appearance, and exceptional quality of light which characterizes the flame arc lamp has rendered it pre-eminently adapted for the economical illumination of large areas, and it is now generally conceded that the flame arc lamp is the most efficient illuminant yet developed, and that the penetrating quality of the brilliant, golden yellow light is such that even under the most adverse atmospheric conditions, such as those imposed by fog or smoke, it provides a highly satisfactory illumination.



G. E. 6.6 Ampere, 110-Volt Vertical Carbon Flame Arc Lamp.

Previous to the advent of the 6.6 ampere vertical carbon d. c. flame arc lamp manufactured by the General Electric Company, the installation of flame arc lamps on 6.6 ampere d. c. circuits was not entirely satisfactory on account of the large and wasteful resistance necessary. This new lamp is designed for connecting directly in a 6.6 ampere d. c. circuit without any change in the system, simply replacing the other lamps where desired.

Although these lamps are now made for d. c. service only, they find a wide application, being suitable for lighting squares, parks, or special store sections in cities where the 6.6 ampere series luminous arc, or the series d. c. enclosed 6.6 ampere systems is used for street lighting. They are adapted for multiple and multiple series service in addition to the above.

The lamps are equipped with a light opal globe and a 26-in. diffuser. The casing, which is of copper with black ozidized finish, is made up in two sections so arranged that, by telescoping the sections, the mechanism is exposed, rendering it unnecessary to remove the entire casing in order to see that the lamp is properly trimmed.

The arc is held in the same position at all times, as the mechanism is of the focusing type. With the exception of this feature, the lamp mechanism is similar to that used in the standard d. c. enclosed lamp, which has given perfect satisfaction during years of service.

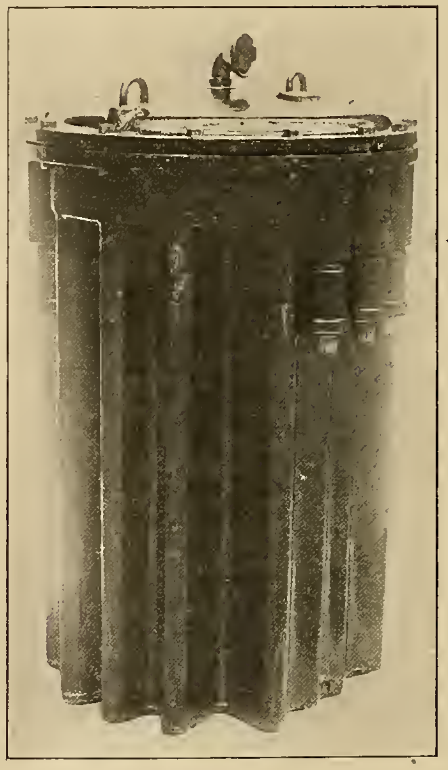
The lower carbon holder is provided with a ball and socket joint to allow perfect alightment of both carbons. A life of about 20 hours is obtained with one trim when the lamp is adjusted for 6.5 amperes. The design and the materials used are such as to combine attractive appearance, great strength and durability with minimum weight.

Particular attention is called to the increased illuminating efficiency obtainable—an average of 2800 mean lower hemispherical c. p. places this lamp on a basis 50 per cent higher than the average flame lamp manufactured in this country or abroad. This increased efficiency, combined with the fact that lamps may be connected directly in the circuit offers the Central Stations operating d. c. an opportunity to take over the lighting of foundries, wharves. etc.

SEVERE SERVICE CONDITIONS REQUIRE IMPROVED MANHOLE TRANSFORMERS.

There is a growing demand for distributing transformers to be installed in underground vaults, called manhole or subway openings, that furnish access to underground systems of distribution. This demand comes from the larger companies who are operating in the big cities, and is for an absolutely first-class unit, with regard to both operating efficiency and adaptability to the service conditions.

As these transformers are installed in subway manholes which are liable to flooding from heavy rains or overflow water, one of the main requirements of service is that the manhole transformers shall be water and air tight; that is,



Improved Manhole Transformer.

the joints between the case and cover and where the leads issue from the case must be water and moisture proof. Hence, it is necessary to enclose the transformer in a hermetically sealed case, and design it for an exceedingly low tempera-

ture rise. This demands careful design as well as the highest grade workmanship. At the same time, the transformer must not only be so constructed that it is possible to make it water-tight, but such that the unit can be installed quickly and easily. Also, it is necessary that the design permit the transformer to be connected to or disconnected from the line without removing the cover or otherwise opening the case.

Any expansion of the oil under a rising temperature, of course, compresses the air in the upper portion of the transformer case and causes a rise in pressure. Under abnormal operating conditions, such as a short circuit, a considerable rise in this pressure may occur, which will make the transformer case liable to serious injury. In order to avoid any danger from such occurrences, a safety or relief valve for any excess pressure should be provided. The completed transformers should be tested at the factory at a sufficient air pressure to insure their being air-tight and moisture-proof.

The Westinghouse type "S" manhole transformer fulfills the foregoing conditions of service and exactions of design and is rapidly increasing its popularity. The magnetic circuits and coils of this transformer are the same as those of the well known Westinghouse type "S" transformer, but they are mounted in a case of special design that adapts them to manhole service.

The accompanying illustration shows the transformer supplied by the Westinghouse Electric & Manufacturing Company to the Kentucky Electric Company, Louisville, Ky., one of the largest electrical companies in the country employing underground distribution. The many advantages of this type of construction have led to its adoption for the entire line of transformers designed for manhole service.

ANOTHER KELLOGG CONTRACT.

G. A. Joy, western sales engineer for Kellogg Swithboard & Supply Company, announces the closing of a contract for a complete exchange equipment for Cape Girardeau Bell Telephone Company, Cape Girardeau, Mo. The new switchboard and apparatus will be installed in a new building specially fitted for the service, the company having purchased the Stone building on Broadway and Ellis street, which will be used as the central office and general offices of the organization.

The entire second story of the big building is being remodeled to suit the needs of the business. Adjoining the large operating room will be rest rooms for the operators, which will be fitted with lounges, chairs and other comforts. The four rooms for the offices will be fitted with modern telephone office equipment. On the same floor will be placed the distributing frames, racks, storage batteries and power plant. Supply and tool rooms will be in the basement.

The switchboard is to have an ultimate capacity of 3000 lines, a present equipment of 1000 common battery lines; ten toll and thirty rural lines. Three sections will be installed at once. The common battery lines are divided among six operators with two additional operators for toll and rural connections.

Each of six common battery positions will be equipped with 15 cord circuits with undivided four party keys for ringing four frequency bells on a metallic line without use of ground. The toll and rural positions will be equipped with combination cord circuits arranged to make connection between toll to toll and toll to common battery lines.

There will be a one position chief operator, and a one position wire chief's desk; a main distributing frame, intermediate distributing frame and relay racks.

The power plant will include the furnishing of storage battery system, a mercury arc, arc rectifier, Kellogg four frequency pole changers, two sets of transformers and slate power board. The equipment will be Kellogg Standard throughout.

BOOKS RECEIVED.

"The Watthour Meter," by Wm. M. Shepard and Allen G. Jones; 179 pages, 5½x8½; 103 illustrations. Technical Publishing Company, San Francisco. Price, $2.00.

The electric generator and the prime mover which drives it have always been in the foreground of interest, but it has taken many years for most engineers to realize that the machines are dead masses of metal without proper switches and controlling devises to make their power useful. In this respect the last years have seen great improvements and in many of our large electric generating systems now give just as much or even more attention is paid to the control of the system as to the generating plant.

The meter, however, which stands at the other end of the system, between the customer and the supply circuit, is still for most electrical engineers an apparatus to which little attention is paid and one of which little is known. The more progressive central station companies indeed, have given a great deal of attention to the meter as one of the most important elements of the system and it is largely due to the efforts of these companies that the meter, just as the incandescent lamp, has reached such a high state of perfection.

Nevertheless it is not yet realized by many engineers that carelessness in the choice of meters and neglect in their care and maintenance may easily lead to losses of revenue greater than all the losses in generators and transmission and distribution circuits to which so much attention is paid, and that the question of properly metering electric circuits in many cases is of as great or greater importance than any other problem which the electrical engineer has to meet.

For this reason the above-named book is a very desirable and useful addition to the electrical literature as it brings before the reader in a short and simple manner and with the least amount of technical formalism, but in easily understood language all the problems of the meter as an element of the electric circuit.

The book deals with the different methods of metering direct current, single phase, alternating and polyphase circuits, two-wire, three-wire and four-wire circuits. It explains the principles and discusses the operation of the different forms of the various types of watthour meters which are in use, such as the induction meter, the commutator meter, etc.

It goes into the discussion of the relation of the meter with the system, the underlying principles of its application, the limitation and possible difficulties met in the meter and numerous other subjects of importance in this field and therefore is a book which will be of interest and benefit to every electrical engineer and should be read and carefully studied.

Charles P. Steinmetz

Flying Machines, Their Construction and Operation. By W. J. Jackman, Thomas H. Russell and Octave Chanute; 221 pages, 5½x7½ inches; well illustrated. The Charles C. Thompson Co., Chicago, and The Technical Book Shop, San Francisco. Price, $1.00.

This volume explains the principles of flying. The various forms of gliders, monoplanes, bi-planes, etc., are discussed and a historical resume of their development traced. From this the transit is short to motor driven machines, details as to the weight and power of the various makes of American and foreign gas engines being included. Full directions are given for constructing such machines by amateurs and many practical hints on handling them. This is a dangerous book to put in the hands of an ambitious boy, for it makes the science of aviation so attractive that he would be tempted to do likewise.

NEWS NOTES

TRANSMISSION.

CLOVERDALE, CAL.—C. A. Feldmeyer, manager of the Cloverdale Light and Power Company, is installing a 500 k.w. regulator at the sub-station at Asti.

BOZEMAN, MONT.—Dr. Carl Schroeter of Chicago is negotiating with the local city authorities with a view of establishing a gas plant at a cost of $100,000.

VALE, ORE.—The City Council has made arrangements for the water and sewerage system for Vale. The American Light & Power Company has been given the contract, the bid being $63,490 for both systems.

TACOMA, WASH.—Wright, Sweeney & Cummings have assigned to Geo. Milton Savage and W. Nichols the contract for constructing the head work and tunnel of the $2,000,000 municipal power plant in the Nisqually river.

BAKERSFIELD, CAL.—The Board of Supervisors sold to the Mt. Whitney Power Company for 50 years, a franchise to erect poles and string wires over the public highways for the transmission of light and power in Kern county.

LEWISTON, IDAHO.—The Lewiston, Clarkston Investment Company has closed a contract with the Washington Water & Power Company of Spokane for electric current to be received at Moscow on a new transmission line to be constructed from Palouse to Moscow, to connect there with the Lewiston system.

OAKLAND, CAL.—An application has been made to the Board of Trustees of the town of Emeryville for a franchise right, privilege and permission to erect, etc., lines for transmitting and distributing electricity along, across, upon and over certain roads, highways, public ways, and streets of Emeryville, by the Great Western Power Company.

BOISE, IDAHO.—E. C. Crocker, vice president of the Snake River Irrigation Company, states that the contracts have been closed for the construction of the dam and power house for the Castle Butte project, located 38 miles south of Boise, on the north bank of the Snake river, between the mouth of the Bruneau river and Swan Falls, the work involving an expenditure of more than $500,000.

ROSEBURG, ORE.—J. L. and S. A. Kendall hydroelectric plant at Roseburg has a turbine connected to a 200 k.w., 60-cycle, 3-phase, 6600-volt alternator during the wet season, but during the dry season the water supply is inadequate, and to care for the load a 20 by 36 "Reliance" type heavy duty engine is being furnished by Allis-Chalmers Company. This will be belted to the generator and will drive it when necessary.

NEVADA CITY, CAL.—The Middle Yuba Hydroelectric Company has received a carload of transformers for the new plant on the Middle Yuba river. They stand eight feet high and just barely passed through the narrow gauge tunnel at Town Talk. Good headway is being made in building the new road for the company from the Middle Yuba river to Minnesota, while it is expected to have the new power line from Pike City to Alleghany completed within the next few weeks.

GUNNISON, UTAH.—The Gunnison Valley Power Company is developing its water power site and has recently placed an order with Allis-Chalmers Company for the necessary equipment. This will include a 540 h.p. single horizontal turbine with cast iron spiral case, operating under a head of 210 feet, direct connected to a 300 k.v.a., 2300-volt, 60-cycle, 3-phase, 450 r.p.m. alternator. A 10 k.w. exciter will be direct connected to an extension of the main shaft. Three 100 k.v.a. oil-filled, self-cooled transformers will be used to step up the voltage for transmission.

PROVO, UTAH.—The Knight Power Company of this city has recently placed an order with Allis-Chalmers Company for the hydraulic turbines to be used in its hydro-electric development at Heber City. There will be two 1650 h.p., 514 r.p.m. single horizontal turbines operating under a head of 170 feet. These turbines will be identical except that different material will be used for the runners of each turbine. The Power Company wishes to satisfy itself as to certain points and has ordered one runner to be made of bronze and the other of cast iron. The result of this comparison will be watched with considerable interest. Another interesting feature is that the turbines will not be provided with governors. A regulating cylinder operated by the penstock pressure which can also be controlled electrically from the switchboard or mechanically from the turbine will be used ordinarily for regulation. In case of emergency a direct mechanical gear can be placed in operation.

ILLUMINATION.

SALT LAKE CITY, UTAH.—Requests for bids on the electric wiring and equipment of the Newhouse theater have been sent to many electrical contractors.

LOS ANGELES, CAL.—A resolution recommending that the City Trustees of Alhambra call a bond election for the purpose of constructing a municipal light plant, has been unanimously adopted by the Board of Trade of that city.

OROVILLE, CAL.—The Great Western Power Company which has begun the work of building a large concrete dam in the Feather river at the intake to the tunnel, has taken the task of solving the labor problem for itself and has a special man in Sacramento hunting men to work at the dam.

OAKLAND, CAL.—Crossed wires started a fire that destroyed the power house and engine house valued at $50,000 on the I. W. Hellman Jr. estate at San Leandro at 9:30 a. m. July 21. The destruction of the power and engine house has temporarily deprived the Hellman grounds of electric lights, though a connection was made with the San Leandro town lighting wires later. The household is depending on a supply of water held in a reserve tank. The reconstruction of the power house will be commenced immediately.

RENO, NEV.—Stone & Webster have assumed the management of the Sierra-Pacific Electric Company. This company owns all stocks of companies which do the entire electric lighting and power business in the cities and towns of Reno, Sparks, Virginia City, Carson City and Silver City, Nev., and in the surrounding important mining and irrigation districts of western Nevada. The companies also do the entire gas business in Reno, Sparks and Carson City, and supply water for domestic purposes in Reno and Sparks. Also they do a very considerable power business with mines and mills, including some of these located on the Comstock lode and in the Yerington copper district. The companies own and operate four hydroelectric plants on the Truckee river. They have a combined capacity of 7300 h.p. As the water-power now developed is insufficient to supply the present and increasing demand for electric power, a new plant of 9000 h.p. will be constructed at once and further developments will be undertaken. It is estimated that ultimate developments aggregating 150,000 h.p. will be made.

TRANSPORTATION.

BILLINGS, MONT.—The Eastern Montana Electric Railway Company, composed of Billings capitalists, has begun the work of making a permanent survey of the line from this place to Bear Creek.

EL PASO, TEX.—The El Paso Electric Railway Company has presented a petition requesting permission to construct tracks along Gladstone and Mundy avenues. A resolution has been adopted giving the company privileges to extend its tracks.

SAN FRANCISCO, CAL.—The San Francisco Electric Railways of which Lewis F. Byington is president, have filed an instrument which leases to the United Railroads for a period of 21 years the rights, franchies and property, including 100 cars, of the Parkside line.

VALLEJO, CAL.—City Attorney William T. O'Donnell is now looking into the law with the view of determining just what legal steps are necessary to have the permit of the proposed electric road of the Vallejo Traction Company to the White Sulphur Springs declared null and void.

HANFORD, CAL.—John B. Rogers, general manager of the Hanford & Summit Lake Railway, announced that surveys will be started in the city of Hanford and from those surveys that the estimates will be made and bids invited for the construction. No city line has as yet been planned but later ordinances will be prepared and franchises sought.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company has decided to make extensive improvements in the matter of trackage immediately following completion of the underground conduit system for electric wires. The first improvement will be the continuation of double tracks from Tenth and P streets along Tenth to Y street. The matter of running a line of cars out E street is also under consideration and in all probability will be approved.

OAKLAND, CAL.—Work has commenced on the six blocks' extension of the Liese avenue car-line from Penniman avenue, to Key Route Heights tract, where it is planned to construct a depot which several lines of the company will converge. This is on the line of the projected extension of the Key Route to San Jose, and it is understood that in addition to the Key Route and Liese avenue lines meeting here, the extensions of the Dimond and East Twenty-seventh street lines will also pass this point. It is expected that eventually the Liese avenue line will be extended to Mills College.

OAKLAND, CAL.—To relieve the crowded condition of the street cars because of the fast growing population of the suburbs and especially the newly annexed East Oakland district, the Oakland Traction Company has ordered built 20 large, modern cars at a cost of $140,000. These cars will be built at the traction company's car shops on Yerha Buena avenue, and will be hurried to completion as fast as possible. The rapid growth of Fruitvale, Melrose, Elmhurst, Fitchburg, and Dimond is said by Supt. W. F. Kelly of the traction company to be the cause of the increase in cars. The heavy passenger traffic to these districts during certain hours of the day cannot be properly accommodated without an additional equipment.

TACOMA, WASH.—The North Coast Railroad, now building across Washington, are preparing to operate the first standard-gauge railroad across the Cascade mountain range by electricity. In the Yakima valley and along the Columbia river Robert Strahorn, president of the North Coast Company, and his associates are developing several great hydroelectric plants. It has become known during the last week that one of the greatest Western electric power projects is being developed at Packwood lake, near the headwaters of the Cowlitz river, approximately ninety miles southeast of Tacoma. The power plant when complete will cost $3,000,000, with transmission lines to Tacoma, Seattle, North Yakima and other towns in Central Washington. The project is said to be intimately connected with the North Coast Railway, with the object of supplying the power by which that railroad will operate its trains across the Cascades.

WATERWORKS.

NORTH BEND, ORE.—North Bend will in the near future be equipped with a modern system of water and sewer works, estimated to cost about $75,000.

TACOMA, WASH.—Contract for the new water system at the county poor farm has been awarded by the Board of County Commissioners to Nevins & McKein for $3678.

SPOKANE, WASH.—The Council has passed an ordidance authorizing and directing the Board of Public Works to enter into a contract with Elmendorf & Elmendorf for water mains in Manito Heights Addition.

ALAMEDA, CAL.—Mayor Noy has received a reply from President Tevis of the water company to his letter regarding an extension from two to ten years of the purchasing option to be given Alameda, in case the city decides to install a distribution system and purchase water from the Bay Cities Company. In it Tevis says that the directors of the company are averse to giving more than a two-year option. Tevis says: 'Any change in conditions would involve a withdrawal of statements made to our bankers and interfere with the company carrying out an arranged form of pledge, and would also interfere with financial negotiations now pending. However. I am assured that if you and your associates in the city government feel that you must insist upon the point, the period will be extended to cover five years from the date at which the distributing system is completed and placed in commission.

SAN FRANCISCO, CAL.—It has been announced in Judge Conley's Court that the Spring Valley Water Company has threatened to cut off the water supply of the steamship companies on July 20 if they refuse to pay the rates as fixed by the injunction of Judge Van Fleet. The rates the steamship companies are willing to pay are those established by the Supervisors last month for the fiscal year 1910-1911. These rates are considerably lower than the injunction rates. William Madden, attorney for the Pacific Mail Steamship Company and the S. F. & Portland Steamship Co., and W. H. Gorrill, attorney for the Pacific Coast Steamship Company, informed Judge Conley they would file complaints in intervention in the Minaker suit so as to enable them to seek restraining orders preventing Spring Valley from cutting off their water supply. The water company appealed to the Supervisors to have $1,000,000 chopped off its franchise assessment. Assistant Manager Behan appeared before the Board of Equalization to call attention to the fact that the amount allowed the company for the expense of "taxation" in making up the annual rates ordinance was $24,000 short of the sum actually charged by the Assessor for taxes. Behan suggested that as the law allowed the corporation to count its taxes along with "operating expenses," in deducting from receipts to arrive at its "income," and that as franchise value was not counted in fixing the rates, the Board should reduce this item from $2,500,000 to $1,500,000. The Board denied the water company's request, and directed the city attorney to file a suit of intervention in the injunction proceedings brought by Dr. A. W. Minaker against the Spring Valley Water Company to prevent it from charging more than the rate for water established by the Supervisors. The action of the Supervisors has taken the burden from Dr. Minaker of raising a bond of $100,000 and prosecuting the action in the courts, as this will now devolve upon the City Attorney and the municipality is not required to give a bond.

INDEX TO ADVERTISEMENTS

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

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FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

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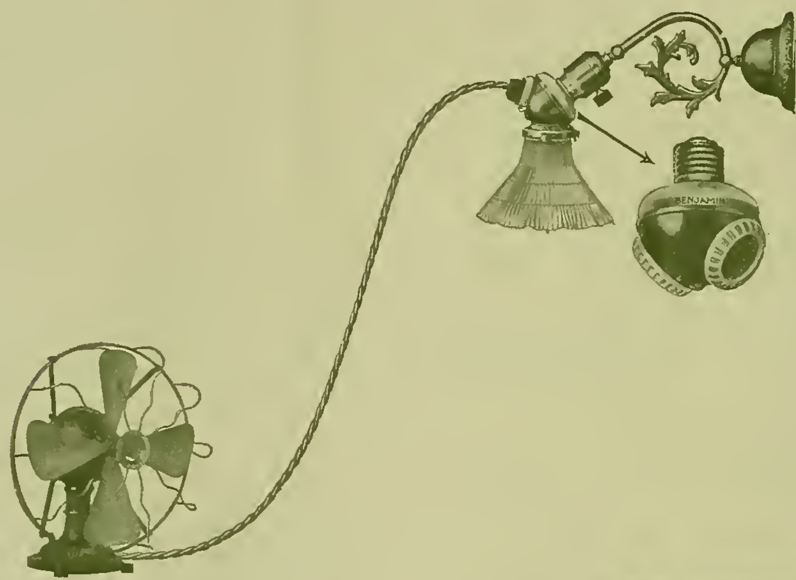

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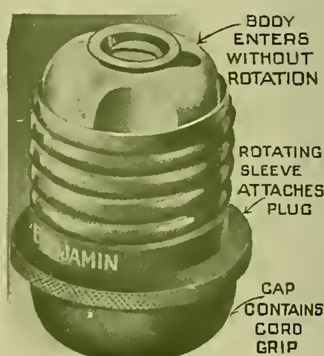

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VOLUME XXV | SAN FRANCISCO, AUGUST 6, 1910 | NUMBER 6


MT. LASSEN

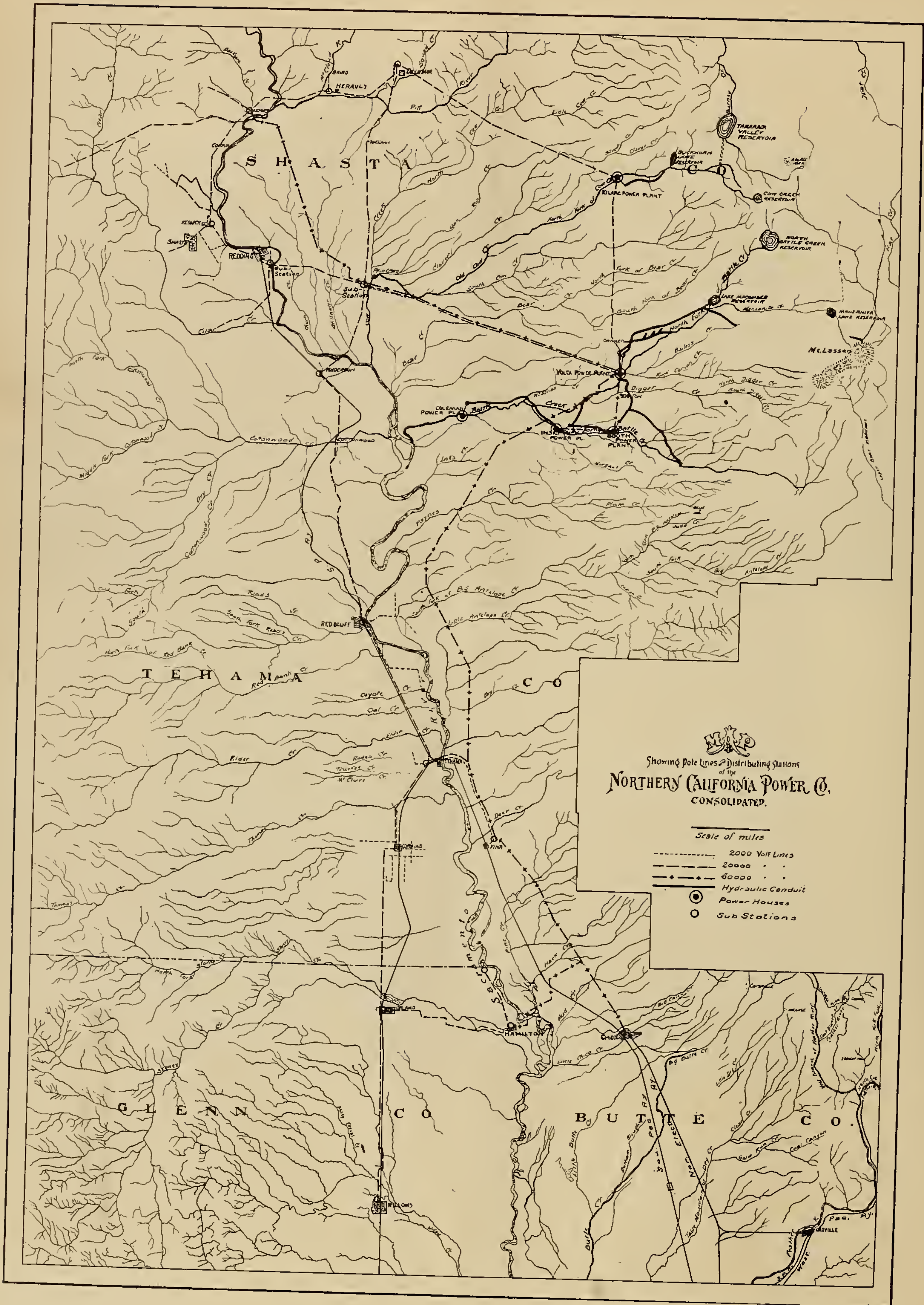
NORTHERN CALIFORNIA POWER COMPANY,
CONSOLIDATED

By Rudolph W. Van Norden

Mt. Lassen in his splendor, isolated from other lesser peaks, stands alone, proudly raising his battered crest like a wounded warrior, who, crushed but undefeated, is monarch of all he surveys. In the dim distance to the north, it is true, his brother peak, Mt. Shasta, higher and more perfect in outline, looms like a white cloud on the horizon; each is a king crowning his own vast domain. We are told, however, by geologists that Mt. Lassen was the highest peak of the Sierra Nevada range many ages ago when it was an active volcano. And that at one time, when the fury of its internal fires grew beyond the bounds of reason for well regulated volcanoes, it proceeded to blow itself up and scattered several thousand feet of its then symmetrical cone over the face of the land. One could easily imagine that this might have been the case, as the two main peaks, Lassen on the left and Brokeoff on the right, appear to be the edges of what was once a giant cone, while the jagged buttes and minarets between them may be the wreckage of a seething crater. At any rate the mountain is still a volcano, very docile, it is true, after its tempestuous behavior, but exhibiting many signs of activity by geysers and much boiling water. That it spread lava to great depths over the country, especially to the westward, has made possible the development of the power system about to be described. For this lava, with its load of cemented gravels and ash, by its porosity, forms a gigantic natural reservoir to conserve the melting snows and supply through thousands of springs of large volume much of the water for this system.

It has long been known that rivers and creeks having their source in the slopes of Mt. Lassen did not behave like most Sierra Nevada streams, whose flow dwindles to a mere fraction of their average during the fall months. The minimum flow of these streams is a high percentage of the average.

There have been for many years a number of small ditches taking their supply from North Battle creek or tributary streams or from springs, which have been used to conduct water to sawmills and in particular to a box factory near Shingletown, on a small feeder running into North Battle creek, known as Millseat creek. It was the use of these early ditches and the water so easily obtained that in the year 1900 was the source of inspiration to Mr. H. H. Noble and associates, to complete the use of this water by the development of a hydroelectric power plant, using a more or less abrupt fall between the old box factory and the point where the water was returned to North Battle Creek.


MAP
Showing Pole Lines & Distributing Stations of the
NORTHERN CALIFORNIA POWER CO.
CONSOLIDATED.
Scale of miles
2000 Volt Lines
20000 " "
60000 " "
Hydraulic Conduit
Power Houses
Sub Stations
SHASTA CO
TEHAMA CO
GLENN CO
BUTTE CO.
REDDING
RED BLUFF
HAMILTON
CHICO
WILLOWS
OROVILLE
VOLTA POWER PLANT
KILARC POWER PLANT
COLEMAN POWER PL.
INSKIP POWER PL.
SOUTH POWER PLANT
TAMARACK VALLEY RESERVOIR
NORTH BATTLE CREEK RESERVOIR
LAKE MACUMBER RESERVOIR
Mt. Lassen
Sacramento
Cottonwood
Sub Station

Funds for the preliminary work were provided and water rights in Millseat Creek were purchased, together with several short feeders deriving their source of supply from springs. A water right in North Battle Creek was acquired and a ditch having a carrying capacity of 3000 miners inches, or 75 second feet, and 2½ miles long was next built. This was known as the Keswick ditch and discharged its contents into Millseat Creek.

There was at the same time a ditch with a carrying capacity of 5000 miners' inches built, which carried all of the accumulated flow of Millseat Creek a distance of one-half mile and emptied it into a forebay reservoir, later named Lake Nora.

This was the beginning of the first plant, and the company was known as the Keswick Electric Power Company.

Later, as the plant was enlarged, other ditches were acquired. One picks up the flow of Bailey Creek on the western slope of Mt. Lassen, and after a distance of two miles, crosses North Battle Creek on a timber flume and trestle and joins the main ditch from Lake Macomber, a storage reservoir in North Battle Creek; it carries 1500 miners inches of water, but the main ditch has a capacity of 2000 miners' inches and the added distance from the junction to Millseat creek, into which the flow is discharged, is 6½ miles. Another ditch, known as the Battle Creek Ditch Company's ditch, also diverts water from North Battle Creek. The company has a majority ownership in this ditch and out of a total flow of 1640 miners' inches, receives somewhat over one-half, which, like the other sources is delivered into Millseat Creek.

From the beginning in 1900 to the present the growth and development of what has now become the Northern California Power Company Consolidated, has been by leaps and bounds. But the successful rise of what appeared to many at first to be an undertaking of great risk, with the possibility for the development of business a very uncertain quantity, has been due to the absolute faith, the minutest attention to every detail, both physical and commercial, a thorough knowledge of prevailing conditions and invincible pluck of one man, Mr. H. H. Noble.

Almost every hydroelectric plant, in California at least, has had little or no load in sight when it was proposed to build the plant, the promoters depending largely on the demand which the future would bring. Yet there is hardly a case where, when the plant was completed and placed in operation, the business did not appear almost as fast as it could be handled, and in many plants the history of their operation has been one of continuous overloads. With the Northern California Company, there was a big sparsely populated territory available; that it had potential values in its deposits of copper and iron ore was known, but outside of a small amount of power to be sold to mines and a considerable electric lighting possibility, there was little industrial development which would form a market for power. Lines were first built to a number of towns; small lighting companies at Redding, Red Bluff and Tehama were acquired on an equitable basis, and a contract to supply power to the smelter and mine of the Mountain Copper Company at Keswick was entered into; power was offered at reasonable rates, and then happened just what the foresight of the founders of this project had believed would come to pass; the industries were attracted by the chance to get cheap power and capital was invested in vast amounts to develop from the natural resources the metals which are in constant demand by the human race—gold, copper and iron.

The smelting of iron ore was, however, not seriously considered, due to the high cost of fuel in this section. It then remained for Mr. H. H. Noble, looking forward to future load possibilities, to introduce a most daring project, the smelting of iron ores by the aid of electricity. This enterprise which will mean much toward the development of the iron and steel industry for the Pacific Coast, he has grappled single handed, experimenting through a long period to final commercial success in the smelters of the Noble Electric Steel Company at Heroult on the Pitt.

The transmission network grew by additions, new lines and enlargements; smelters, quartz mines, copper mines, industrial railroads, pumping plants and factories, were added to the load until a territory 100 miles long and 50 miles wide is now covered. But this growth of load meant more power to be developed; as fast as new machines were added they were

Tamarack Valley.

Site for dam, Tamarack Valley Reservoir. Lower end of valley in the background.

loaded and still other sources of power became imperative. This has resulted in the succession of plants, using much of the same water over and over again, which are described in the following pages.

Watershed and Storage.

There are three distinct watersheds, the first, which is the largest, is also the most prolific, not alone from its size but because of the remarkable underground storage. This is the watershed of Battle Creek and the small streams which lie between the two main branches. The principal source of supply is the western slope of Mt. Lassen and the area drained is about 337 square miles. The second watershed is that of Old Cow Creek and covers an area of 37 square miles. Unlike the Battle Creek watershed, there is little or no underground supply, the result being that this creek acts like most California streams, in that the flow throughout the summer and fall months is but a very small proportion of its volume during the rainy months, then again the greatest altitude is but 8000 ft., while that of the first named is over 10,000, and the area while heavily timbered is much smaller.

The third watershed is that of Burney Creek, which discharges its flow into the Pitt River. This watershed is also small and is adjacent in position and similar in production to the Cow Creek watershed. It has an area of about 20 square miles.

Burney Creek would be of little value to a power plant, as the low-water flow is insignificant and the fall per mile is small. But this latter feature fortunately is exaggerated, at least in the district known as Tamarack Valley, and makes possible an enormous reservoir. Between Tamarack Valley and Cow Creek is a ridge, so low, that if the former were less than 100 ft. higher in altitude, water would flow over the ridge. The valley is oval in shape, two miles long and a mile and one-half wide, flat as a table top, but with a narrow outlet making a good dam site. This reservoir, when flooded to a depth of 35 ft., will cover 1540 acres and there will be impounded 29,500 acre-feet of water or 1,285,020,000 cu ft.

It is proposed to drive a tunnel 6990 ft. long from the upper or southwesterly side of the reservoir, under the low ridge already mentioned and thereby carry the stored water into Cow Creek.

This storage is ample to supply all of the water necessary to operate the Kilarc plant, after an additional installation of 3000 kw. is made, over any low-water period of which there is a record.

The Burney Creek watershed is therefore to be used only in conjunction with and as supplementary to Old Cow Creek.

The dam for Tamarack Valley will be a hydraulic-fill earth structure with a concrete core; it will have a length on the crest of 900 ft., a total height of 35 ft. and a width at the base of 106 ft.

Delivering its flow from the north into Cow Creek is another storage reservoir, Buckhorn Lake. This was originally a natural lake and seems to have been an ancient crater; its level was raised by a timber crib-dam and when full has a useful content of 320 acre-feet and covers an area of 20 acres. It is very prettily situated between rugged hills and is surrounded by a dense forest.

There are at present two storage reservoirs in the North Battle Creek watershed. The oldest, Manzanita Lake, at an altitude of 5800 ft., is in one of the feeders to the south; it nestles on the slope of Mt. Lassen, a crystal gem in a wilderness of surpassing

Excavating for Tamarack Valley Dam.

beauty and grandeur. This was originally a natural lake, but a storage capacity of about 1400 acre-feet has been created through the building of a timber dam.

Lake Macomber was originally a meadow through which North Battle Creek flowed. An earth and dry rock dam and embankment was built here at a comparatively low cost and a storage capacity of 2300

Manzanita Lake and Lassen Peak.

acre-feet was thus acquired. Before this reservoir was made, there was much conjecture as to whether it would hold water, the volcanic, porous nature of the underlying rock and the resulting possibility of leakage being a problem which caused some hesitancy in proceeding with the work. The reservoir was however built, and, as predicted, it leaks slowly. But this is a blessing in disguise, as it only tends to add more water to the underground supply, making new springs and the old ones a little larger and a little more constant, but all eventually finding its way into the ditches of the system.

All of the ditches empty into Millseat Creek, from which the flow is diverted into Lakes Nora and Grace, the forebay reservoirs for the Volta plant.

The use of the water after passing Volta is described further on in this article, together with the ditches and other features. The constant increase in the demand for power has, however, made the normal supply inadequate and there is being now constructed at the headwaters of North Battle Creek a large storage reservoir to conserve the stormwaters. This site is at an elevation of 6700 ft. above sea level and the outlet narrows to a gorge, making a good site for a dam. Work on this dam under the supervision of Mr. Emmet W. Sutcliffe, an engineer of many years' experience in Pacific Coast power plant practice, was commenced in the summer of 1909, following designs which were carefully worked out by Mr. Sutcliffe after a study of the particular conditions to be met with at this altitude.

The dam is to be a dry wall, rock-fill structure with a facing on the up-stream side of concrete, varying in thickness from 3 ft. at the crest to 7 ft. at the heel. The profile has a gravity section, although the crest is wider than would otherwise be necessary, were it not for the precautions which must be taken in encountering heavy snow and ice jams against the crest. Originally it was proposed to carry this dam to a height of 60 ft., but eventually the plan was changed and the base made wider to give an ultimate height of 100 ft. above the original bedrock surface which was taken as a datum line from which to work.

There is a curious bedrock condition in this gulch, the bottom and the south side is a hard and homogeneous lava, while the north bank is disintegrating syenite; the latter is not considered of a good enough quality to be placed in the dam. The lava is therefore being used entirely and a large quarry has been opened in the south bank directly behind the dam.

Lake Macomber. (1) View of Lake, Latour Butte in background. (2) Dam, showing Waste Wier and Fish Ladder.

Site of the Battle Creek Storage Reservoir, headwaters of North Battle Creek; Mt. Lassen in the distance.

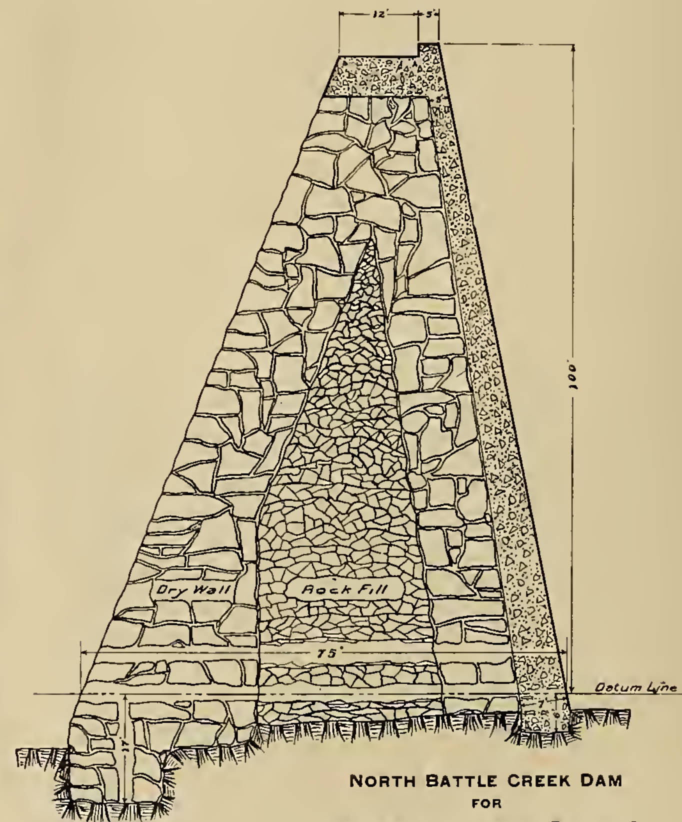
the work. Fuel for the hoisting engines is cut from timber close by and the amount used so far, for engines and camp, has been 3200 cords. The cost, as given by Mr. Sutcliffe, covering surveys, preliminary work, camp, bunkhouse, shop, hoist and compressor and quarrying and placing of stone has amounted to $22,000, or a total cost of $4.40 per cu. yd. of stone in place. The completed dam will have a length on the crest of 658 ft. and a cubic content of 56,000 cu. yd.;

Partially Built Dam for Battle Creek Storage Reservoir.

of this there will be 7000 yd. of concrete in the base, back face and crest. The reservoir formed will have a capacity of 14,800 acre-feet, or 189,000,000 cu. ft.; the area covered will be 600 acres, and the area of the watershed tributary to this reservoir is seven square miles.

Volta Power House.

It would seem that Nature, in her arrangement of things, had anticipated the use of her mountain streams to assist in the extraction of the metals from the ores which she had conveniently buried, not so far away. It would be difficult to find anywhere a site for a hydroelectric plant more perfectly arranged than the one on which the Volta plant is placed.



NORTH BATTLE CREEK DAM
FOR
NORTHERN CALIFORNIA POWER CO.
DESIGNED BY E. W. SUTCLIFFE.
1909

To the north of North Battle Creek is a ridge, set somewhat back from the creek, but paralleling it. The top of this ridge is wide and forms a sort of plateau, which extends with a gentle slope to the headwaters of North Battle Creek. It is this plateau, with an underlying porous lava formation, that forms

There had been excavated from the quarry, up to June, 1910, 8500 cu. yd. of rock. Of this amount 3500 yd. were discarded and 5000 yd. has gone into

the great underground reservoir fed by the melting snows of Mt. Lassen.

Near the edge of this ridge, above the power house, are the two forebay reservoirs, Lake Nora and Lake Grace, and each delivers its contents into its individual pipe line. These reservoirs were originally pasture meadows, and their creation was a simple matter of building low earthen embankments on two sides.

The Volta plant was built in 1901, operation commencing in October of that year. The plant as originally designed was to contain three 750 kw. generators, although but two were installed at first. Lake Nora was built at this time and was supplied largely from springs through a number of small ditches. The question of a Fall shortage of water, so vital to many other power systems in California, did not enter here; the great underground reservoir is always faithful and knows no seasons.

In 1906, when the Volta plant was enlarged to its present size, a second pipe line was installed and Lake Grace was built to supply it . This reservoir is some 2,000 ft. to the rear of the first one and the two pipe lines form, when viewed from a distance, an enormous letter V, the initial of the name of the plant. The country people thereabouts insist that this coincidence was premeditated, but the company says that this is but one of the many proofs that nature intended to have a plant in this spot. At any rate it is a pretty conceit and a good advertisement.

Surrounding the reservoirs and stretching away to the high mountains is a magnificent forest of pine and fir. To the east Mt. Lassen raises its jagged and snow covered summit; to the south and west one has an unobstructed birds-eye view over five counties, one of the most extensive and beautiful to be found in California.

Lake Nora has an area of five acres, while that of Lake Grace is 8.43 acres. Each has a timber forebay containing a set of grizzlies and a double set of fine wire-mesh screens, both placed on a slant to facilitate cleaning any floating debris which may accumulate on them.

From the edge of the ridge to the power house is a fall of about 1,200 ft. The grade is fairly uniform and, while too steep to ride a horse down comfortably, is an ideal grade for a pressure pipe.

The older pipe has a length of 6,200 ft., and the head on the pipe is 1,196 ft. Beginning with the reservoir there is 1,000 ft. of wood stave pipe, 36 in. diameter. The remainder is riveted and lap-welded steel, all 30 in. diameter and varying in thickness from 1/4 to 3/4 in.

The new pipe has a length of 8,400 ft., while the head is 1,254 ft. The first 3,000 ft. is of wood-stave construction, 48 in. inside diameter. The remainder is part riveted and part lap-welded, the diameters varying from the upper end of 36 in. and a thickness of 1/4 in., to the lower end with a diameter of 24 in. and a thickness of 11-16 in.

Through a connection in the power house, explained further on, the two pipes are operated together. An interesting hydraulic paradox thus exists, the head on one pipe being more than 50 ft. greater than that of the other, yet they equalize, due to the relatively high friction losses, as perfectly as a well mated team of horses.

(1) Lake Grace. (2) Wood Stave Section of Pressure Pipe from Lake Grace to Volta Power House.

The power house is placed at the foot of the slope, where the country spreads out in a more or less level manner. There is an abundance of room for all buildings and out-buildings.

Originally the power house building was 30 ft. wide and 75 ft. long within the main part. It contained three generating units. Parallel to the main part and to the rear of it was a room, 15 ft. wide, in which was placed the transformers.

In 1906 the building was lengthened on its west end, to accommodate a fourth generating unit of 2,000 kw. capacity; this addition being necessarily 10 ft. wider than the older part, due to the increased size of the machinery.

In 1908 the fifth unit of 2,400 kw. capacity was added. The transformer compartment was also extended to provide for additional transformers. In 1906 a separate switch-house, 50 ft. wide and 75 ft. long was erected directly in the rear of the main building.

Both the power house and switch house have heavy rubble-masonry walls, two ft. thick, a type of construction which has been adopted by this company as standard for all of its power houses. The roofs are of galvanized corrugated iron, supported on timber trusses. In the power house a corrugated iron ceiling is suspended from the lower chord of the roof trusses for protection from the danger of fire and also for the sake of appearance.

There is a machine and forge shop conveniently situated a short distance from the power house and beyond this is the dormitory and superintendent's cottage, the former being a comfortable frame structure for the operators of the plant.

Volta Power House. (1) Front view, showing discharge from water-wheels. (2) View of Power House, Switch House and Pole-Top Disconnecting Switches. (3) No. 4 Generating Unit, 2000kw. (5) Interior of Switch House.

The first three generating units have a rating of 750 kw. each. The generators are three phase, of the revolving armature type, operating at a speed of 300 r.p.m. and delivering current with an e.m.f. of 500 volts. The frames and bases with pedestals and bearings are self-contained. These machines have been particularly reliable in their eight years of practically constant operation. They carry overloads most of the time.

The water wheels consist in each case of a single runner on which are mounted cast-steel buckets within a cast-iron case. They are of the tangential type, as are all of the water wheels of this system, so far installed. The shaft is supported in two bearings, similar in type and appearance to those of the generator. The shaft terminates in a heavy cast-iron flange, as does also the generator shaft. Between these flanges is a rawhide-link coupling.

The nozzles are of the deflecting type, operated by type F Lombard governors. The nozzle tips are of the plain or straight variety. Water is supplied from a transverse header placed parallel to and in the rear of the building. The older pipe feeds this header at its middle point.

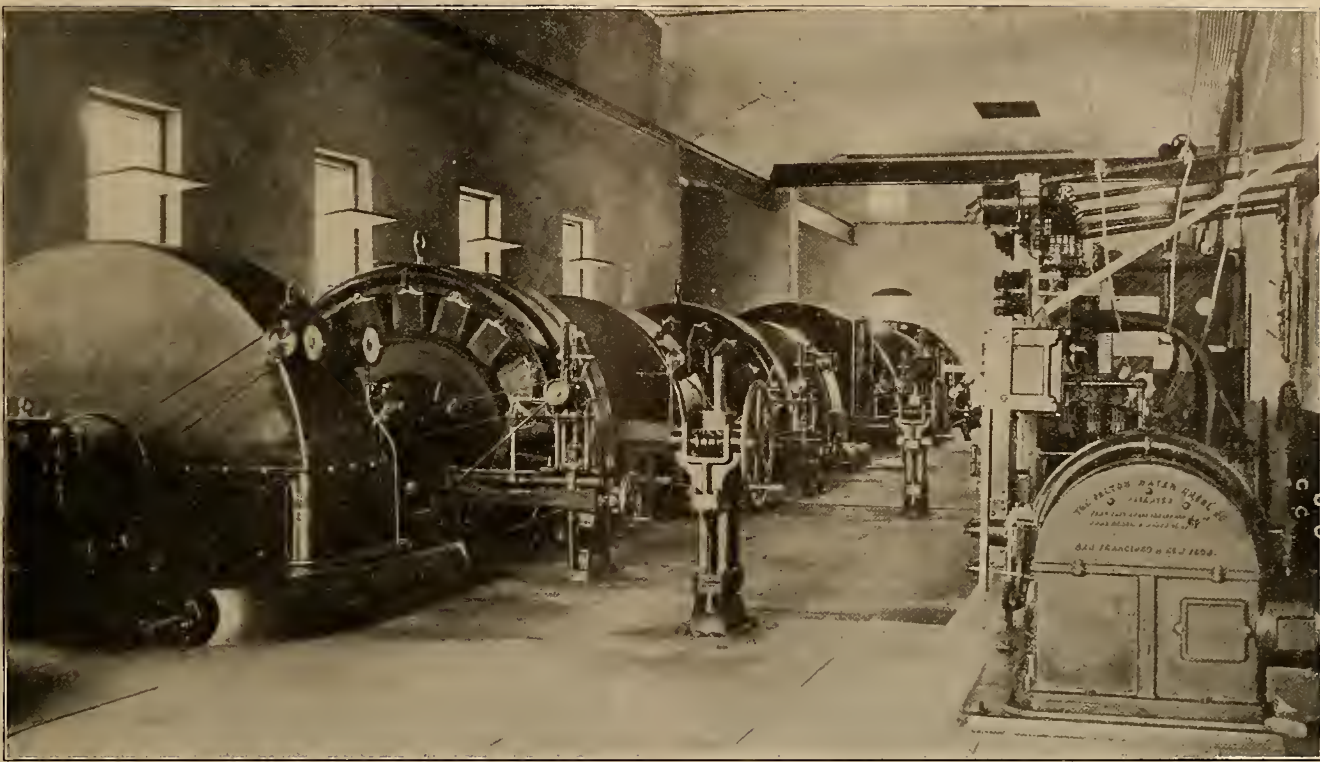
The fourth unit has a rated capacity of 2,000 kw. It consists of a generator of the so-called "water-wheel type," with revolving field and stationary armature. It operates at 300 r.p.m. delivering three phase current at a potential of 2,200 volts.

There are but two bearings, mounted on the masonry foundation. The water wheel is "overhung," that is, it is mounted at one end of the shaft, outside the bearing. It consists of a single runner on which are bolted cast-steel buckets, within a sheet steel housing. The nozzle is of the needle type, and is stationary. A type Q Lombard governor controlls the admission of water to the wheel by operating the needle in the nozzle. This water wheel was built by the Abner Doble Company of San Francisco, while all of the other main water wheels in this plant were furnished by the Pelton Water Wheel Company.

The generators were furnished by the Westinghouse Electric and Manufacturing Company, except the fifth unit, which was built by the General Electric Company; it is rated at 2,000 kw., and both the generator and water wheel are similar in type and specification to the fourth unit, just described. The nozzle of this water wheel differs, however, in that the needle is operated by a hand screw, while the governor, which is a Replogle, of the mechanical type, regulates by deflecting the nozzle, thus throwing the stream away from the buckets of the water wheel.

The second pipe line is carried directly through a worm and gear operated gate valve to the nozzle of the fourth machine. At some distance back of the building a feeder is tapped off of this pipe and is carried through a gate valve and then through a reversed, cast-steel three-pronged Y to the nozzle of the fifth machine. A second pipe is tapped off of the old pipe line and is brought diagonally across in the rear of the building and after passing through a gate valve, enters a branch of the Y casting. To the third branch of the Y is a third gate valve for use in the event that another pipe line be installed.

The exciter water wheels are operated by water



Interior of the Volta Power House, the older section in the foreground.

under a head of 500 ft. This water is diverted in Mill-seat creek and is carried through a ditch to a point directly above the power house, whence it is delivered through an 8-in. pipe. The source of this water is a large spring, near the top of the ridge, but in the bed of the creek. It has the advantage of being an independent and constant source for the exciters and as it is crystal clear makes an ideal operating medium for the governors. The governors are all operated by water from this source, but under a head of but 250 ft. Water is let down to a timber head-box, containing screens; from here it is carried to the power house in a 4-in. wrought iron pipe and distributed to the governors after passing through a Lombard triple screen.

There are four exciter sets, each having a 45 kw. multipolar generator delivering direct current at 125 volts; each is direct connected to its own water wheel, fitted with needle nozzles and enclosed in a cast-iron case. The first two sets are placed, one on either side of the switchboard; one of them has a 50 h.p. 500 volt induction motor coupled with it. This motor is supposed to be always connected to the live bus-bars on the switchboard, and, being operated by the water wheel at synchronous speed, "floats" on the circuit. Should a water wheel nozzle, which has a very small opening in these machines, become plugged with debris in the water, the motor automatically picks up the load, thus obviating the possibility of shutting down the exciters with the resultant loss of field and shut down of main machines.

The third and fourth exciters were installed separately, one for the fourth and the other for the fifth generating unit, and are equipped with type F Lombard governors.

There are two switchboards, the first, installed with the original plant, has four white marble panels. Three of these panels control the three 750 kw. generators, while the fourth is for the exciters. On each generator panel are mounted three ammeters, one voltmeter with a 3-point switch to connect to each phase, one d.c. field ammeter and one polyphase indicating watt meter. There are two sets of knife switches for the generator circuit which are connected to the two sets of bus-bars mounted on the rear of the switchboard. The exciter panel contains the regulation volt and ampere meters and exciter switches. The main leads from the generators to the switchboard are carried through the concrete floor in vitrified tile conduit.

The second switchboard has two generator and one exciter panels, also of white marble. The arrangement is similar to the old switchboard, except that the generator switches are of the remote control, oil-immersed type and are placed above and to the rear of the switchboard. The switchboards and apparatus were furnished by the Westinghouse Electric and Manufacturing Company.

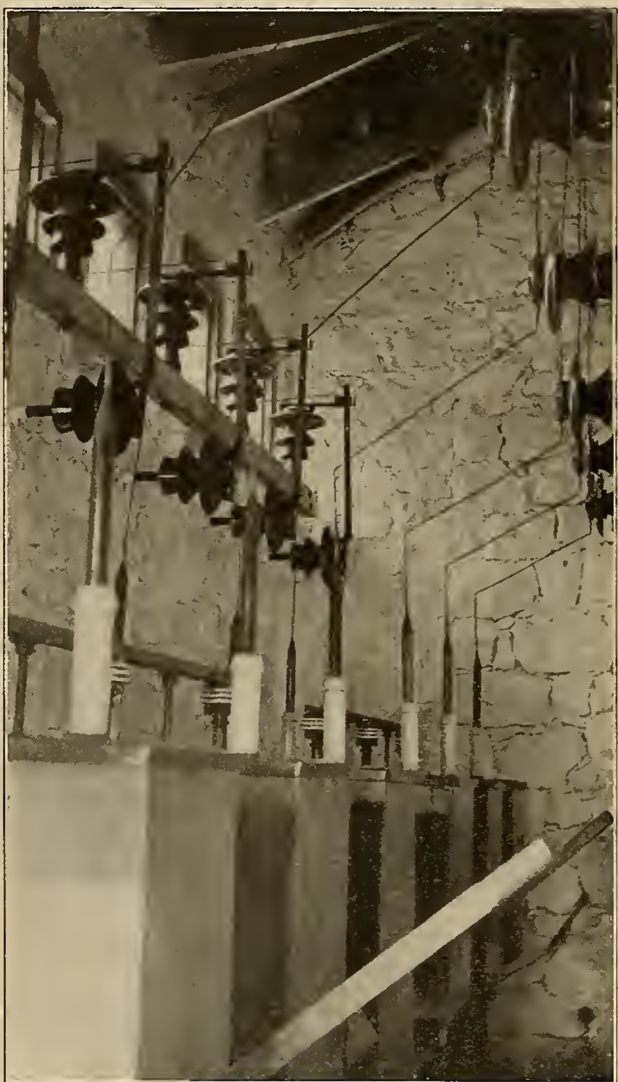
Conveniently placed are water-level indicators to show at all times the level of water in the reservoirs. This device consists of a Weston voltmeter across the terminals of a No. 10 iron wire circuit. In series in this circuit, at the reservoir, are a number of 16 c.p. lamps which are automatically cut out by the movement of a float. There is impressed on this line the 125 volt direct exciter current, the variation of the lamp resistance and resultant variation of voltage at the voltmeter causing the proper movement of the needle.

A Brunswick ice machine, driven by a 1 h.p. single phase General Electric motor, gives a goodly supply of ice, which is a very welcome luxury during the summer months.

In the older section of the transformer house are nine 300 kw. Westinghouse, oil-immersed, air-cooled transformers, having a voltage ratio of 500 to 22,000

volts. Separated from these by a fire-proof wall are three 875 kw. General Electric water-cooled transformers, stepping the voltage from 2,200 to 66,000 volts, with star connection. Beyond these is a third compartment with three transformers similar to the last described.

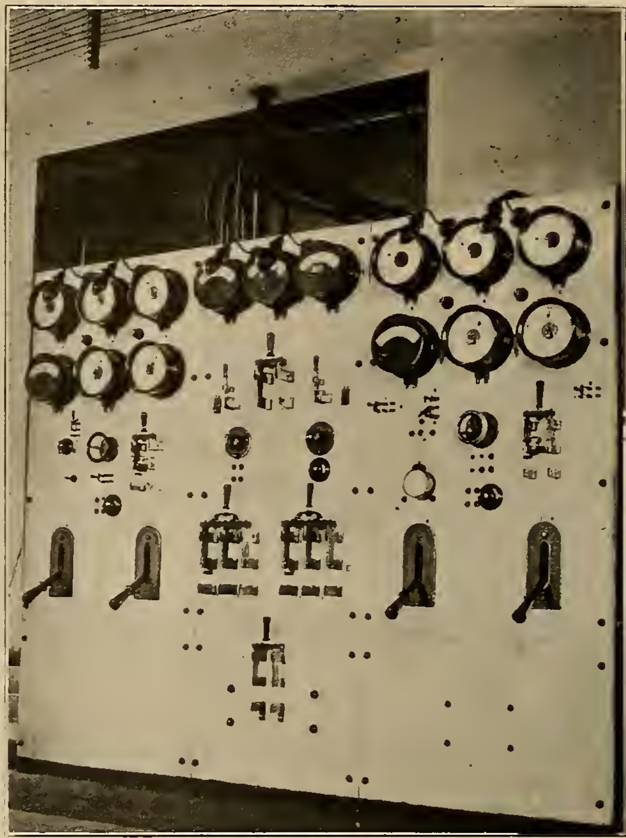
In a room at the extreme corner of the building are two sets of "Kelman" 66,000 volt electric trip and manually closing oil circuit-breakers, one set for each bank of 66,000 volt transformers. These switches are of the pantograph type and seem to have proven the correctness of the principle involved by their satisfactory action on all occasions.



Kelman Oil Switches at Volta.

This switch should not be confused, by those familiar with the history of the development of high tension circuit breakers, with a crude experimental switch, built many years ago, at a time when the requirements for opening high tension circuits were imperfectly understood and switch development was in its infancy.

The construction of the switch is simple: It consists of a rectangular tank containing oil; the two leads are carried down through the cover in heavily insulated bushings to within a few inches of the bottom. A wooden rod having a vertical motion passes through the center of the top, between the lead bushings; to



Second Switchboard at Volta Power House.

this are hinged bronze strips which in turn are linked to a common point in the center of the tank. The movement is similar to that of the points of umbrella ribs, while the motion of the rod could be likened to the ferrule which slides on the center stick of the umbrella.

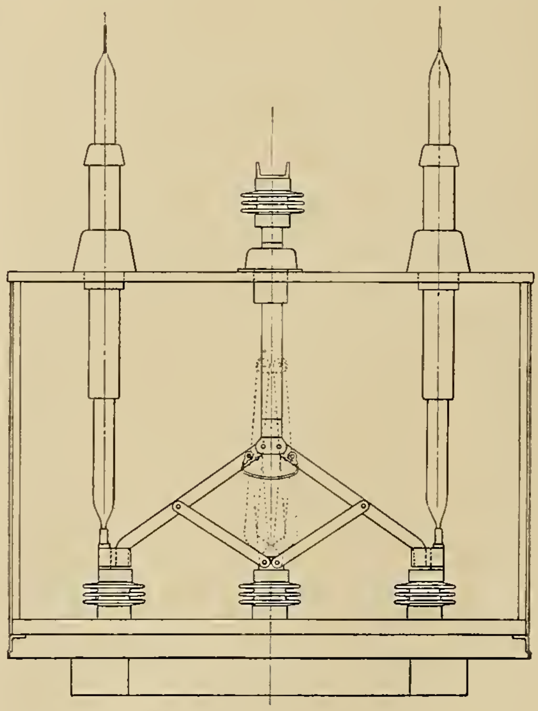
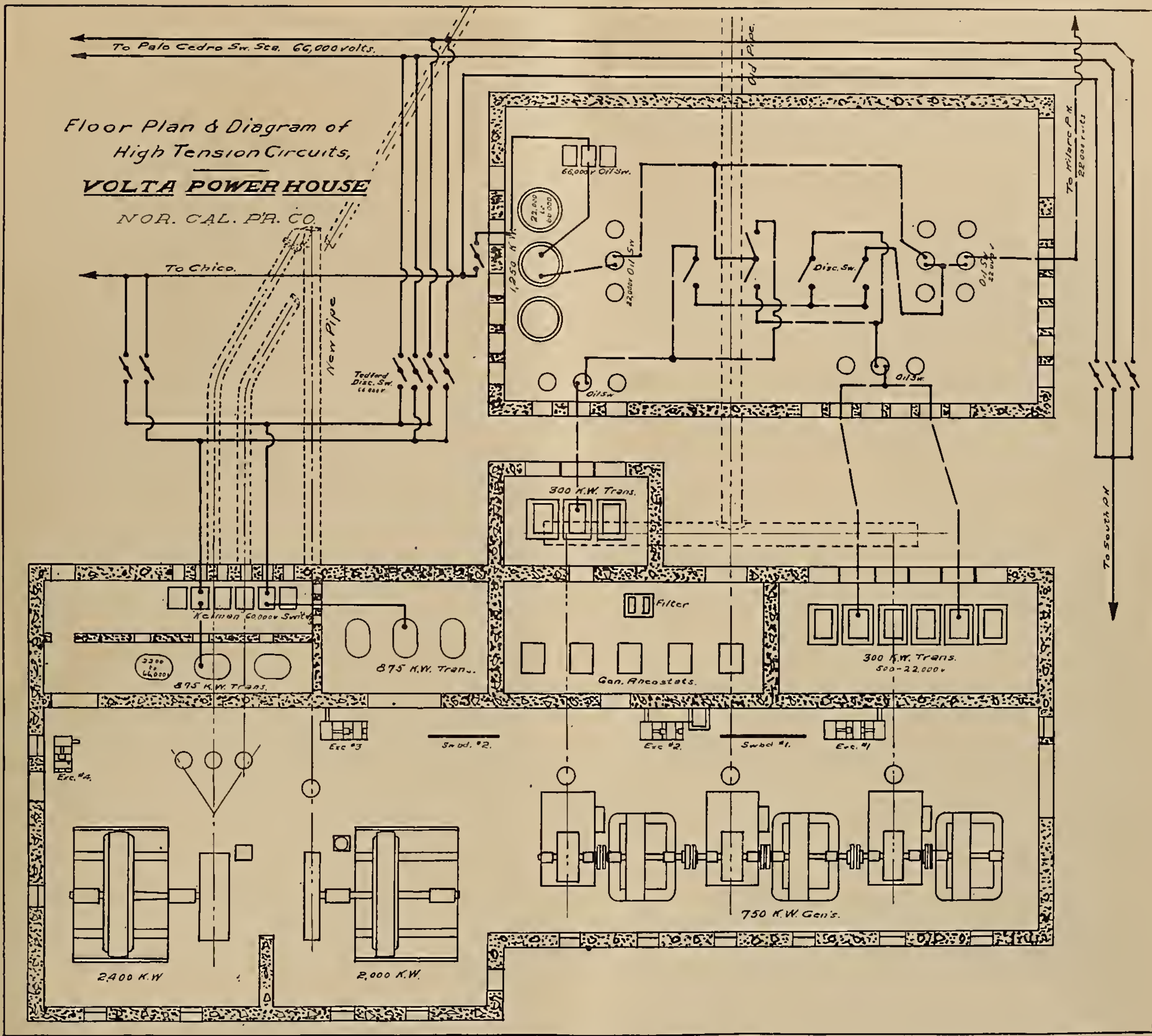


Diagram of Kelman Switch

The object of the pantograph movement is to give a horizontal break to the circuit, thus, at all times, maintaining the maximum head of oil over the break. This seems to be the secret of successful operation of



Plan of Volta Power House, showing arrangement of circuits.

oil-switches, where high voltages and heavy currents are to be controlled.

The circuits from the 22,000 volt transformers are carried into the switch house, as is also a circuit at the same voltage from the Kilarc power house. Within are disconnecting switches, which are a modification of the Masson-Taylor type. With these all necessary combinations of the circuits can be made. The accompanying one-wire diagram and plan shows the arrangement of all circuits.

There is in this building a set of three 1,250 kw. Westinghouse transformers, having a voltage ratio of 22,000 on the primary side to 66,000 on the secondary side, with star connection. This arrangement is a temporary one and was necessary that these transformers might get their current from either the Volta or the Kilarc plant. A voltage regulator is connected to a number of taps at the neutral end of the high tension windings of each transformer.

Radiating from this point are four transmission lines. One, having two circuits, one of which, operating at 22,000 volts, goes to Palo Cedro switching station and from thence are various branches to Redding, the smelter district and the west side of the Sacramento valley, as far south as Willows. This line will be changed to a 66,000 volt circuit and the 22,000 volt network will be fed through the De la Mar and Hamilton connections. The other operating at 66,000 volts is carried directly to Kennet and adjacent points. The second, a 22,000 volt line, is a single circuit to the Kilarc power house. The third line has a single 66,000 volt circuit and goes to Chico. The fourth line is similar and is a tie line between this station and the South Power House.

All circuits, after leaving the switch house, are carried to pole-top disconnecting switches. These are of the two-break, horizontal revolving type, but have, in addition, arcing horns, to facilitate the rupturing of any possible arc. Each jaw of the switch is equipped with a horn, while the swinging piece carries an inverted V, or double horn, which is given a spiral bend so as to be effective throughout the opening of the switch. These switches were designed and erected by H. A. Tedford, the superintendent of the plant. Each line is also equipped with pole-top, horn-gap arresters, for protection from lightning. The line, in all cases,

is connected directly to one horn, while the other is connected to ground without resistance.

South System.

Originally the discharge from Volta found its way to North Battle Creek to follow that stream throughout a drop of 1,500 ft. to where it joins the Sacramento river. The utilization of this drop, together with that of the South Fork of Battle Creek and the addition of the flow in both of these streams, was the basis on which three remaining power plants of the Battle Creek system were designed.

The flow from Volta is now conducted through a ditch which has a capacity of 3,000 miners inches or 75 second-feet. This ditch follows a more or less irregular course, crossing North Battle Creek, at which point the natural flow of this stream is added. The ditch is now being enlarged to carry 4,000 miners inches.

Outlet of Tunnel on South Battle Creek Ditch, immediately above the union with the ditch from Volta.

At a point five miles from Volta a junction is made with the South Battle Creek ditch and from there on it is known as the Union ditch. This runs for three-quarters of a mile, to the forebay of the South power house.

The South Battle Creek ditch carries the flow diverted from the stream of the same name. There is a small masonry diverting dam and the length of the conduit is five miles. There are along the route seven tunnels, aggregating one and one-quarter miles in length. The longest tunnel is 4,260 ft., there is another 700 ft., and the one just preceding the junction with the Volta ditch (shown in the view) is 1,270 ft. long. The rest of the tunnels are short.

These tunnels are all unlined, being cut through a self-supporting lava formation. The grade of tunnels and ditch is 0.2 percent. The tunnels have a clear opening 7 ft. wide and 4½ ft. high on the vertical sides, to the spring of the arch roof. The height at the center of the opening is 6½ ft. The carrying capacity of this conduit is 5,000 miners inches.

The total overall cost of the tunnels, not including the cost of the compressor plant, was $59,514.29, or $9.02 per running foot. The cost of the long tunnel alone was $32,772.26, or $7.68 per foot. These costs are surprisingly low and speak well for the management of the work.

A short distance before the South Power House forebay is reached there is a masonry waste wier or easement, built at the side of the ditch; it has a gently sloping top to facilitate the removal of any water to be wasted at this point; the edge is at the high water mark, so that any extra flow or backing up from the forebay due to regulation in the power house is handled automatically.

The forebay is a rectangular masonry structure. At its entrance are two timber sluice gates, operated by a rack and gear. Across the center is a grizzly made up of flat iron bars, set on edge, the whole being placed at a slant to facilitate cleaning. Behind the grizzly are heavy wire-mesh screens.

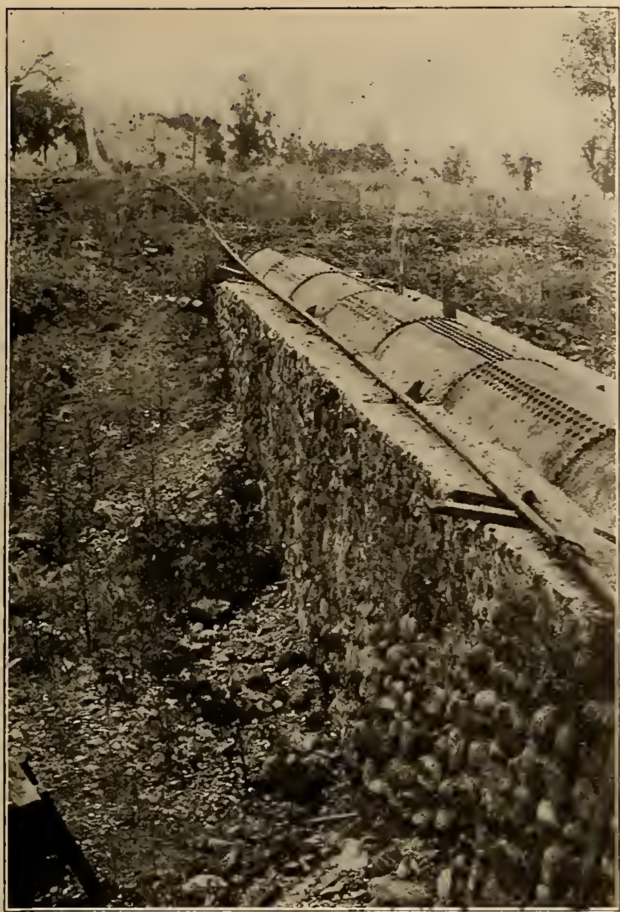
The pipe is inserted through the front wall and has an opening 72 in. in diameter. The pipe then tapers to a diameter of 54 in. and remains this size to within 400 ft. of the power house, where it is reduced to 48 in. This pipe was built by the company, the flange-steel sheets of the proper thickness and size being purchased in the Eastern market and delivered on the ground. It was punched, sheared and scarfed in the East and rolled and riveted together on the ground. The thickness varies from ¼ in. at the top to 9/16 in. at the lower end, the total weight of the pipe being 366,000 lb.

The fall or static hydraulic head on this pipe is 515 ft. and the length is 1,980 ft. The grade is fairly uniform, increasing slightly as the lower end is approached, the pipe being laid above ground for the entire distance. It is well underpinned with loose rock, carefully laid, which affords a satisfactory hold to the ground. Immediately before entering the power house the pipe is imbedded in a rubble masonry anchor wall 100 ft. long, its length being parallel to the pipe. The joints throughout are hot riveted, following standard practice.

The power house building is 32.5 by 70 ft. inside, the walls are of rubble masonry, 2 ft. thick, the roof is of corrugated iron supported on wood purlins which, in turn, are carried by steel trusses. The building is pleasing in appearance and, situated as it is at the edge of a very picturesque stream, gives an effect of simplicity and harmony.

The discharge from the waterwheels is directly into South Battle Creek, which is followed for a short distance and is then diverted and taken into the canal supplying the Inskip power house, five miles further down the stream.

The attractive feature of this power house is its extreme simplicity and efficiency. But one operator is required on a shift and, at that, there is very little for him to do, aside from the alertness and intelligence



Pressure Pipe to South Power House.

necessary in operating any large system at the moment when something happens.

There is one main generating set and one exciter. The Westinghouse generator is rated at 4,000 k.v.a. and delivers three phase current at a potential of 6,600 volts. It is of the water wheel type, has but two bearings and a speed of 225 r.p.m. The bearings are water cooled and have piping arrangements for forced feed of the lubricating oil; this latter feature is, however, not found to be necessary and is not used. The shaft is hollow and its interior surface is water cooled.

The water wheels are two in number, that is, there are two runners, 7 ft. in diameter, fitted with steel buckets bolted to the wheel center; one on either end of the generator shaft, "overhung" outside of the bearings; each is in its own sheet steel housing.

Upon entering the rear wall of the power house flow in the pipe divides, passing through a cast-steel Y, thence, in each branch, passing through a worm and gear operated cast-steel gate valve to the nozzles. These are of the stationary needle type and are fitted with cylindrical deflectors over the stream, operated by a type Q Lombard governor.

The exciter is a 55 kw. multipolar generator, direct connected to an overhung water wheel within a cast-iron casing and fitted with a needle nozzle. This set supplies direct current at a potential of 125 volts.

The switchboard is conveniently placed in front of the generator and has two Vermont blue-marble panels. On the generator panel are mounted 3 a.c. ammeters, 1 field ammeter, 1 voltmeter, 1 indicating wattmeter, 1 graphic recording voltmeter, 1 graphic recording wattmeter, operating control for one remote control, electrically operated generator oil switch and the trip-control for two sets of electrically operated Kelman high tension oil switches. The switchboard was furnished complete by the Western Electric Company, mounted with indicating instruments by the Wagner Electric Company and graphic instruments by the Westinghouse Electric and Manufacturing Company.

South Power House Ditch System. (1) Junction of South Battle Creek Ditch with the Volta Ditch and the Union Ditch in the foreground. (2) Wasteway. (3-4) Views of Forebay and Sluice Gates.

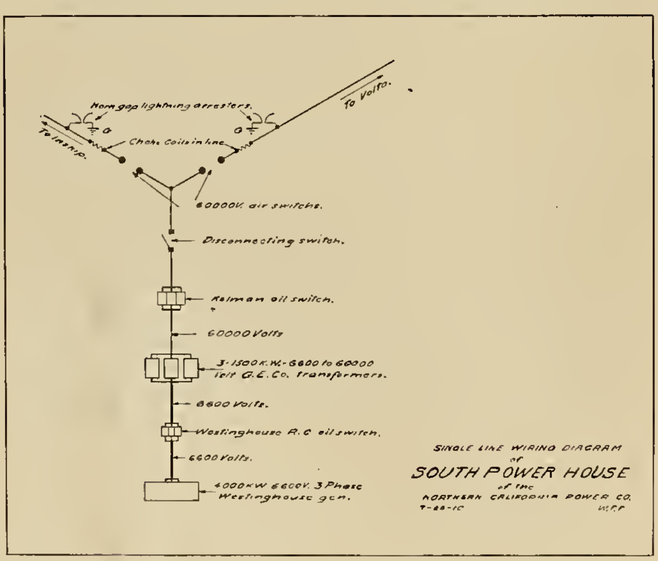
The exciter panel is mounted with the usual instruments and knife switches for two exciters and also contains a reservoir indicator similar to those already described.

At the west end of the building there are four compartments open to the main room, but separated from each other by concrete walls. Three of these

The South Power House.

compartments contain three 1,500 kw. General Electric transformers. They are of the standard water cooled type and are wound for 6,600 volts on the primary and 66,000 volts when star connected on the secondary side.

In the fourth compartment is placed the main generator switch. In a gallery, reached by a steel ladder, directly above this compartment are the Kelman high voltage switch sets, and over the transformers is a line of bus-wires connecting with it. From here the high tension lines are carried through windows fitted with plate glass panes to pole-top disconnecting



switches similar to those in use at Volta. There are also horn-gap lightning arresters. There are two transmission lines, one is the tie line before mentioned between this station and Volta, the other is a tie line to the Inskip power house.

The governor is operated by water under the full static pressure. The water is not, however, taken from the main pipe, but through a pipe laid the entire distance from the forebay. Here water is passed into a vertical drum which contains a screen, and the governor supply pipe leads from this drum. The pipe is a 4-in. standard wrought iron pipe for about one-half of its length, but for the remainder of the distance it is 2½-in. extra heavy pipe. There is a second screen inserted in the supply at the governor.

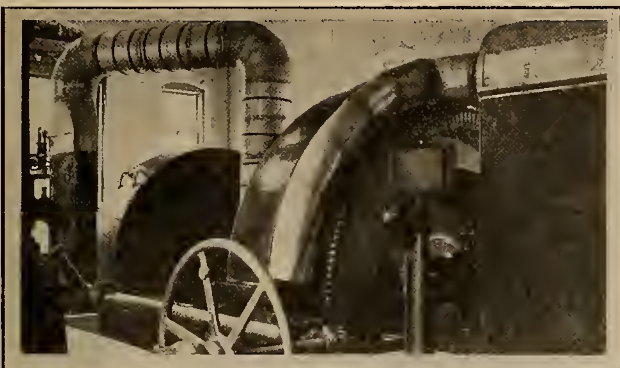
In the interior views of this plant it will be seen, that on the upper half of the frame of the generator on one side and the lower half, on the other, is a galvanized sheet iron casing to which is attached a large pipe of the same material. There is in the waterwheel pit considerable air suction due to the discharge. This suction was utilized by removing the cast iron plates over the nozzles and erecting a rectangular chimney of sheet iron. This connects to the sheet iron pipes and the suction through them is regulated by dampers. The core holes in the generator frame on the sides opposite the casing are plugged up. The effect of this device is to draw air through the ventilating ducts past the armature bars and the laminations, thus producing a ventilation which keeps the generator temperature within safe limits at all times. This very ingenious device was conceived and installed by an employee of the company, G. H. Murphy, although the same idea has been suggested by others, not knowing that it was being used here.

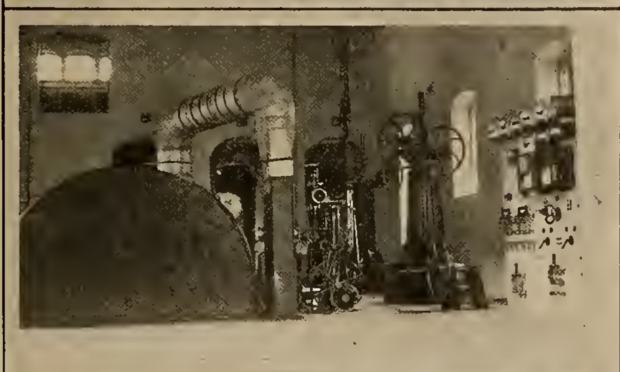
The Inskip System.

This system has been recently placed in operation. It derives its water supply mainly from the discharge of the South Power House, but receives also a smaller supply from North Battle Creek and a number of small creeks—that water which gathers between the line traversed by the Volta to South ditch and the Inskip plant.

A rubble masonry dam, having a gravity, ogee section, diverts the flow of South Battle Creek, a short distance below the South power house, through a set of sluice gates and a short tunnel, into the Inskip ditch.

This ditch has a nominal carrying capacity of 200 second feet or 8,000 miners inches; it is 4.45 miles from the intake to the forebay of the Inskip plant, including five tunnels and a short section of flume crossing Ripley Creek. The grade throughout is 0.2 percent, equal to 10.4 ft. per mile. The open ditch is 8 ft. wide on the bottom and 5.5 ft. deep to the berm line; the sides slope ½ horizontal to 1 vertical.



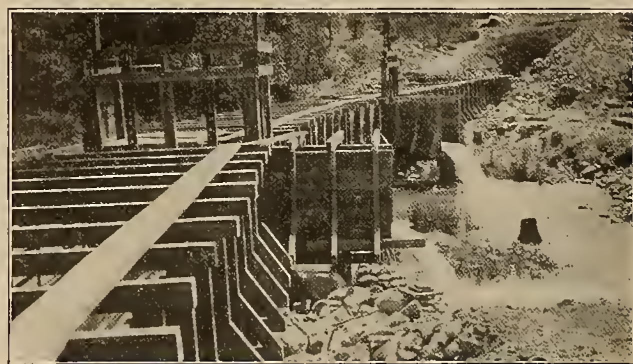


(1) 4000 kw. generating unit, South Power House. (2) Interior of South Power House, Transformers and Kelman Oil Switches seen in compartments in background.

A part of the ditch was excavated with a 1½ yd. capacity, Marion Steam Shovel, and the remainder by hand work. A comparison of costs is interesting and shows that, even through hard pan and rock, this modern method of constructing mountain ditches of large capacity is economical and advisable. The ground throughout is cemented gravel and lava, requiring blasting. The excavated capacity averaged 3 cu. yd. per running ft.

The overall cost of the ditch by pick and shovel methods was $4.00 per running ft. The cost with the steam shovel was 16 cents per cu. yd. The shovel was operated two shifts per day at a total cost of $36. To the cost of excavation is added blasting and cleaning up after the shovel. These costs per running ft. were as follows: Blasting, 60 cents; shovel, 43 cents; cleaning up, 80 cents; making a total of $1.83 per ft. as the cost of the ditch.

It has been the policy of this company to do its work in a manner to insure permanency and low cost of upkeep. With this in view, it has steadfastly refused to use timber flume for carrying large amounts of water, if it were possible to obviate its use. It has even gone so far as to drive crescent shaped tunnels, where timber flume might easily have been employed at one-third of the initial cost. The only piece of flume on this canal is used to cross Ripley creek and acts as a waste wier and sand box; it is short, the entire length being shown in the illustration, and is constructed in the most substantial manner; it is 8 ft. wide and 5 ft. high with three wasteways. The view of the ditch directly below that of the flume is of a section excavated by steam shovel taken from the same spot as the first view but in an opposite direction.

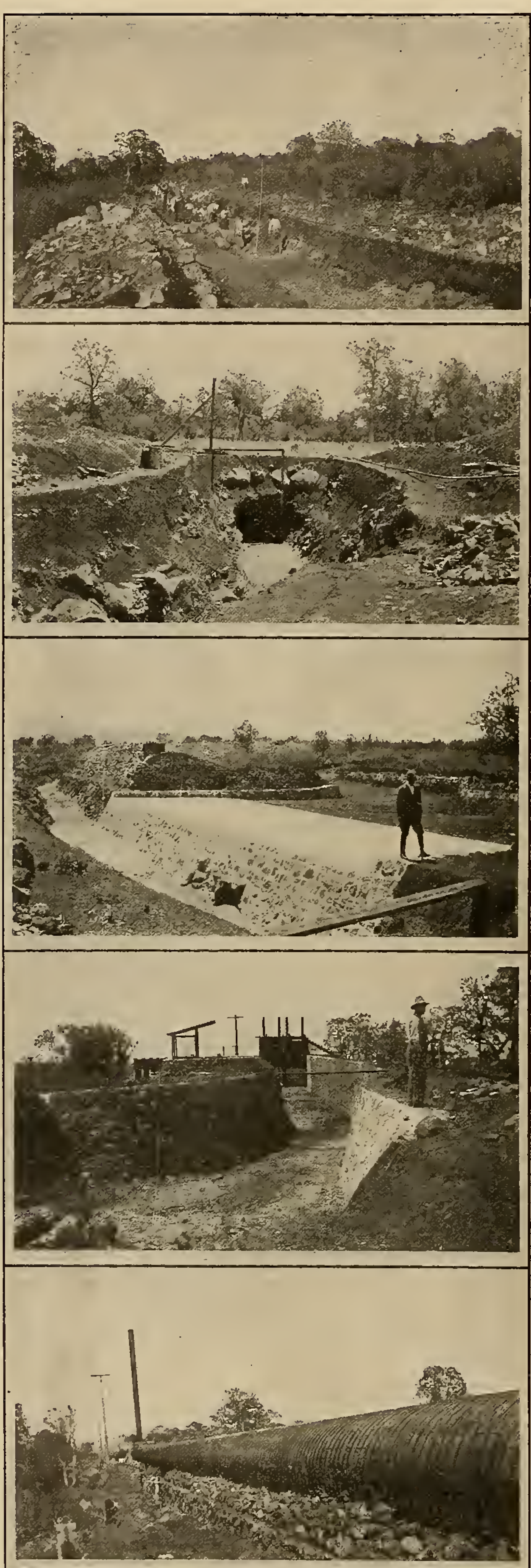


Flume Crossing Ripley Creek.

Section of Ditch Built with Steam Shovel.

The first and second tunnels have lengths of 1,779 and 1,212 ft., respectively, and are straight. The third is 729 ft. long and has three curves, the tunnel dipping into the hill to avoid what would otherwise have been flume in unsafe ground. The fourth consists of two sections, of 295 ft. in all, the first being straight and the second curved. The fifth also consists of two sections, the first having one curve and the second two; the respective section lengths are 418 and 516 ft. Material encountered in the tunnels was wash boulders, lava and volcanic ash.

The tunnels have a clear width of 10 ft., a vertical

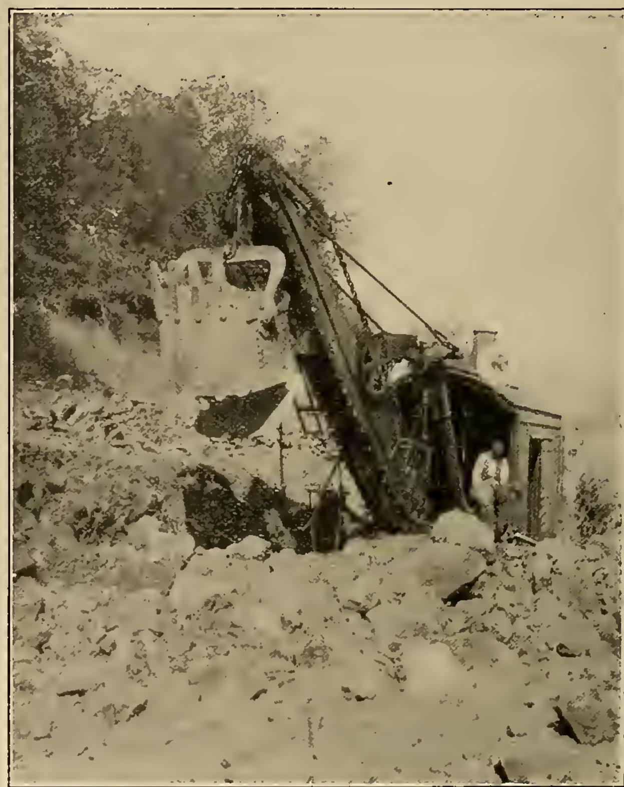


Inskip Ditch System. (1) Excavating North Battle Creek Ditch. (2) Outlet of last tunnel. (3) Waste wier. (4) Entrance to the forebay. (5) Wood stave section of the pressure pipe, 6 ft. diameter.

height of 5.5 ft. to the spring of the arch and a total height of 8 ft. The excavated area averaged 75 sq. ft., and the cost varied from $9.20 to $9.60 per ft., although one section, where considerable difficulty was encountered, cost up to $16.00 per running ft.

The ditch from North Battle Creek has a carrying capacity of 5,000 miners inches and is at present under construction. The work is being done largely with the aid of the steam shovel.

The main ditch from South Battle Creek and the one from North Battle Creek join at the entrance of the forebay. This is similar in appearance, but somewhat larger, than the forebay for the South Power House. It is rectangular, with heavy rubble walls, and



Steam Shovel at Work Building Ditch.

is divided into three sections. The first two, which are opposite the rack and pinion operated sluice gates, have a low concrete barrier between them and sloping concrete floors, which can be drained and cleaned by means of gates placed in the rubble wall. The third compartment is separated from the second by a sloping grizzly and wire mesh screens. From the end of this compartment water passes into the pressure pipe.

A short distance from the forebay is a timber tank, divided into three parts. In each division wall are openings in which are inserted movable screens of fine-mesh brass wire. Water from the main pipe is brought to one end of this tank and passes through the screens, and is then led out of the other end into a 3½-in. steel casing which eventually reduces to a 2½-in. wrought iron pipe. This supplies water to operate the governors in the power house.

The pressure pipe has a length of 3,162 ft.; of this distance the wood-stave section is 2,160 ft. long and the steel section 1,002 ft. The inside diameter throughout is 6 ft. The wood-stave pipe is built of

the best selected red fir, only the heart of the tree being used, care being taken to eliminate knots and all but straight grained pieces. The timber was cut and finished in the mill owned and operated by the company. The pipe is held together with ⅝-in. round steel bands in two sections with two shoes of standard pattern, the spacing of which varies from 10 to 2 in. to the running ft. The unit cost of this pipe, exclusive of the steel bands, but including the laying, was $1.56 per running ft. The steel pipe varies in thickness from ⅜ to ½ in. and is hot-riveted throughout.

A receiver, which is a continuation of the pipe, lies alongside and parallel to the power house building; it is imbedded in concrete. The diameter is 6 ft., but after passing the three outlets to the first generating unit, tapers to 42 in. On its upper side, near its extreme end, is a drum containing a screen with a cleaner, operated by a screw and hand wheel; from this drum water for the exciters is carried through a 12-in. steel pipe. The static head is 378 ft.

The power house building is 125 ft. long and 37.5 ft. wide. It is divided transversely into two parts, the larger containing the generating machinery and the other the transformers and high tension apparatus.

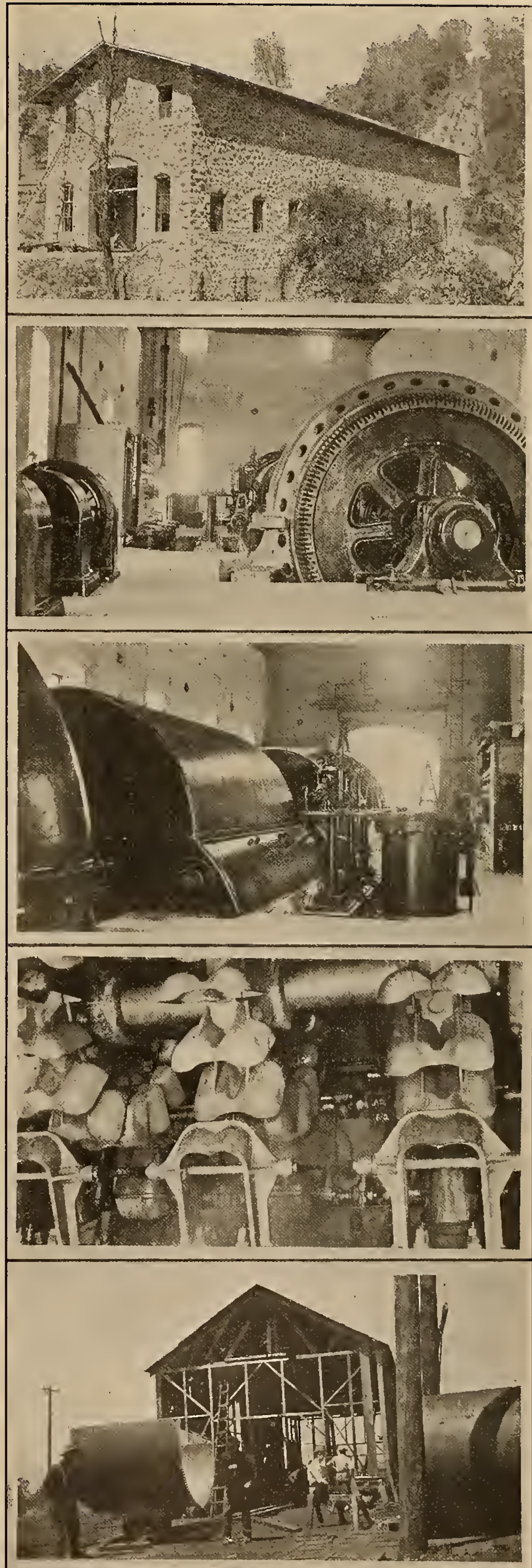
There are two main generating units, arranged so that the water wheels are adjacent. The first unit has a capacity of 4,000 kw. The generator delivers three phase current at a potential of 6,600 volts; it is of the water wheel type and has a speed of 225 r.p.m. There are three bearings, so that both the rotor and the runners are between bearings. The shaft is continuous. The waterwheels consist of three runners, having cast-iron centers and buckets, the latter being cast in pairs. There are two nozzles for each runner, the rear or upper nozzle being of the needle type, operated by a screw and hand wheel, the forward or lower ones having plain tips. Deflecting hoods are fitted to intercept the stream from each nozzle, and they are operated in unison by a type Q Lombard governor. Water is furnished each pair of nozzles from the receiver through three pipes, each of which is fitted with a 27-in. hydraulic gate-valve. The operating cylinders, which are supplied with water under full pressure, are 27 in. diameter. This large diameter, and the resulting enormous pressure on the gate admits of very slow closing against any resistance which might be offered.

The second unit is similar to the first, except that the capacity is 2,000 kw. and there is but one nozzle, like the rear nozzles in the first unit, for each runner. The hydraulic operating gates are also smaller, the diameter of both gates and cylinders being 21 in.

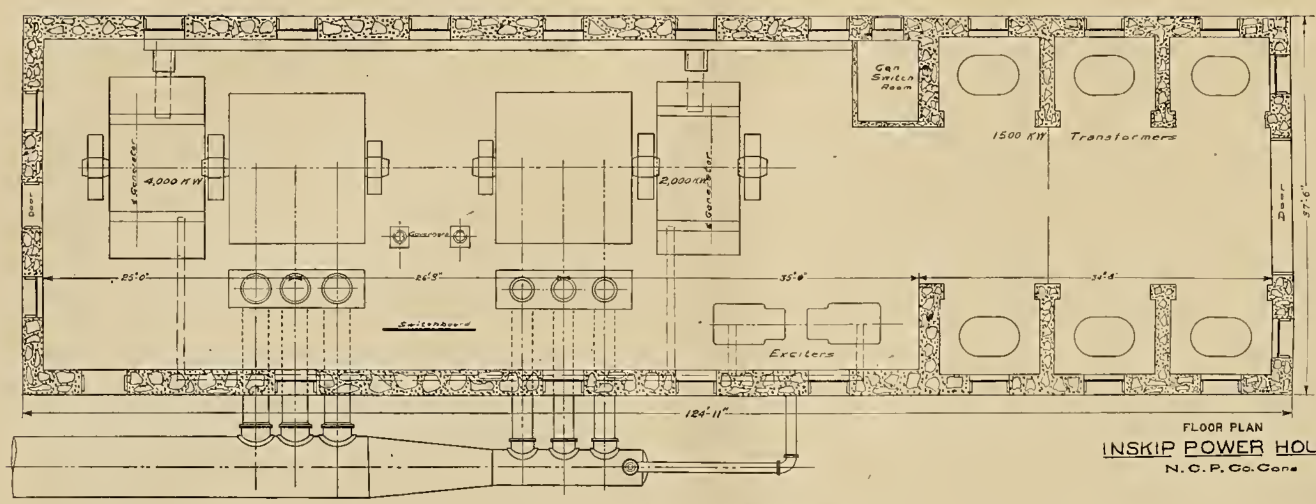
There are two exciter sets, either one capable of supplying excitation for both main generators. Each consists of a General Electric, 6-pole, 120 volt, 60 kw. generator connected to an overhung water wheel, equipped with cast-iron housing and needle nozzle.

All water-wheel apparatus in the Inskip plant was furnished by the Pelton Water Wheel Co.

The switchboard has one exciter and two generator panels; these are similar in mounting and equipment to those on the South Power House, except that the indicating instruments were furnished by the Westinghouse Company. There are two sets of generator bus-bars and consequently four sets of remote-control, generator oil-switches. These are placed in a



Inskip Power Plant. (1) Power House, showing pressure pipe in the background. (2) Interior, showing exciters and 2000 kw. generator in foreground. (3) Interior, looking towards opening into transformer sectian. A corner of 4000 kw. generator and 5000 h.p. water-wheel housing and hydraulic gate valves in foreground. (4) View of the interior of the 5000 h.p. water-wheel, showing runners, nozzles and deflecting hoods. (5) Pipe Shop.

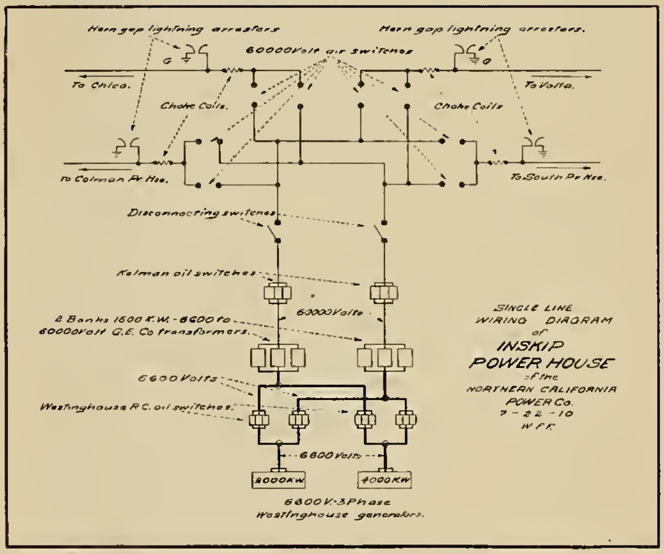


Plan of Inskip Power House.

fire-proof compartment at the end of the generator room.

There are six 1,500 kw. General Electric raising transformers, having a voltage ratio of 6,600 to 66,000 with star connection. The transformers are placed in individual cells having concrete walls, there being three on one side and a like number on the other side of the building, the passageway from the main entrance separating them.

Within the gallery over the transformers are the high-tension bus-lines and two sets of Kelman oil circuit-breakers.



Three circuits pass out of the building to pole-top disconnecting switches. These, at the present time, constitute a loop in the Volta to Chico transmission circuit, and the tie line to South power house.

The Coleman Plant.

This is the final and largest division in point of capacity, in the development of the Battle Creek watershed. All equipment for this plant is in process of manufacture and work on the ground is now well under way.

Water will be diverted by means of a masonry dam in South Battle Creek, immediately below the Inskip power house, and will be carried in a ditch in a north-westerly direction, skirting the hills between the two main forks of Battle Creek, crossing the North Fork and then following the ridge westward, which, further east, forms the drop at Volta, to a point about four miles above the junction of Battle Creek with the Sacramento River. Here a fall of 479 ft. is available. Water will be furnished to three main generating units through two pipes varying from 84 to 60 in. diameter. The generators will each have a capacity of 4,000 kw. and will be driven by Francis scroll case turbines having a rated output of 7,000 h.p The generators and turbines are being built by the Allis-Chalmers Company. Four 4,000 kw., 3-phase, 6,600 to 66,000 volt transformers and complete equipment of electrically operated, remote control, oil circuit-breakers, disconnecting switches and multiple cell arresters are being furnished by the General Electric Company.

This plant will represent the most modern practice in design and workmanship, and will be a notable addition to the many hydroelectric power plants for which the Pacific Coast is famous.

The transformers at South, Inskip and Coleman plants, while differing in size, are built to the same specifications for voltage and regulation, all having taps from 6,600 to 5,400 volts on the primary side, proportioned to give changes on the secondary in 2,000 volt steps.

The Kilarc System.

A description which would do justice to this division of the system would not be complete if only to give an outline of the various mechanical and electrical features. For the setting, in the wild grandeur of its mountains and forests, the wonderful variety in its coloring and yet the simplicity and fitness of it all, entwines this system, in itself a gem among power plants, in an atmosphere of romance. A steep, rocky canyon, the mountains on either side rising to heights of two and three thousand feet, the sides to the very bottom covered with a primeval forest of fir, spruce and pine; the edges of the creek growing in almost tropical profusion with wild rhubarb, dogwood and other flowering shrubs, a veritable riot of color in the deep shadows and brilliant high-lights. Such is the stream whence water is diverted for Kilarc.

To divert 3,500 miners inches of water out of a mountain stream, as a rule, requires a considerable diverting dam; not so here. This diversion has a con-

crete dam of the gravity overflow type; it is 1 ft. high and contains something less than 3 cu. yds. of concrete. It can be seen in the left of the picture. A large granite boulder on one side and another in the middle confine the stream so that it must flow over the dam, when not diverted. The intake to the ditch, with its sluice gates, shown on the right of the picture, is placed in a space blasted out, between the boulder and the south bank.

The ditch is 3¾ miles long from the intake to the forebay. There is, in this length, about 1½ miles of timber flume. This flume was adopted as a temporary expedient to obviate, for the time being, the cost of tunneling. There are, however, four tunnels, the one known as No. 2 having been recently bored to replace a section of flume.

The ditch is cut 4 ft. deep below the berm line; the depth of flow is 3½ ft. It is 8 ft. wide on the bottom and the top varies from 12 to 13 ft.

Tunnel No. 1 has a section of 3 by 5 ft. and is timbered; it has a length of 217 ft. Number 2, which is partly through hard rock and partly through lava ash, is timbered; it has a clear section of 6 by 7 ft. and a carrying capacity of 4,500 miners inches. The grade is 0.1 per cent. The cost of this tunnel was $5.50 per lineal ft.

Tunnels Nos. 3 and 4 have lengths, respectively, of 20 and 60 ft.; they are through rock and are not lined; their sections are 5 by 5 ft. The timber flume is carried through them. The grade of these tunnels, as well as that of No. 1, is ¼ in. to the rod.

The ditch empties into the forebay reservoir—seen in the background of the view of this reservoir—which covers 6 acres. It holds sufficient water to operate the power house for a period of eight hours, if no water were coming into it.

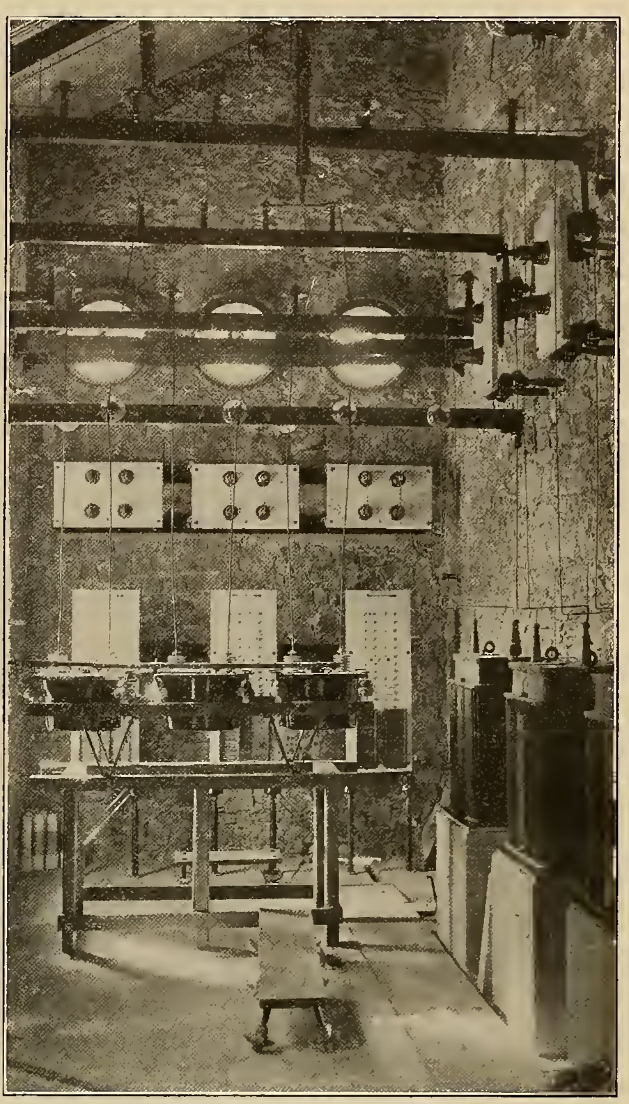
A timber forebay, equipped with screens, is placed well away from the banks of the reservoir, and from this a single steel pressure pipe is carried down the hillside to the power house. The first 600 ft. is, however, wood-stave construction, 60 in. in diameter.

The pipe has a total fall of 1,200 ft. in a length of 6,000 ft.; the steel part has a diameter of 42 in. and a thickness of ¼ in. at the top and a diameter of 36 in. and thickness of 13/16 in. at the power house. It is hot-riveted throughout, with butt and strap joints at the lower end.

The Kilarc power plant was placed in operation in 1903 and was thus the second installation of the system. It consists of two main buildings, the larger one containing the power generating machinery and the other, transformers, oil-switches and lightning protection. Both buildings follow the same general type of heavy masonry wall construction employed throughout the system and are placed parallel to the pressure pipe, one on either side. That section of the pipe lying between the buildings acts as a receiver and from it there are six horizontal outlets, two each for the two main generating units and two for the two exciter sets.

The main generating units are so arranged that the shaft line is parallel to the length of the building and the machines themselves are set "right and left handed," so that the water wheels face each other. The generators, built by the Westinghouse Company,

Kilarc Plant. (1) Diverting dam and intake in Cow Creek Canyon. (2) Forebay Reservoir. (3) Kilarc Power House and Transformer House. (4) Interior of the Power House. (5) Full load discharge in water wheel tail race.



Lightning Arresters, Static Interrupters and Oil Switches at Kilarc.

are rated at 1,500 kw. each; they are of the revolving field type, with cast base and pedestal bearings and operate at 300 r.p.m. They deliver three phase current at 2,200 volts. The water wheels are inclosed in a combination cast and wrought iron casing, have their own pedestal bearings and the shafts are connected with the generators through rawhide link couplings. There are two runners in each housing, equipped with steel buckets, bolted to cast steel centers. Water is supplied to the runners through deflecting nozzles, one of them being of the needle type, the needle of which is regulated by a hand wheel (seen in the left of the foreground of the interior view), the other nozzle has a plain tip. A type Q Lombard governor regulates the deflection of the nozzles; but there is in addition a hand regulating device, to be used in case of emergency. This is worked by a slanting hand wheel, through a thread and nut. In the rear of the nozzles are the main worm-and-gear-operated gate valves. The lowest view is interesting to the engineer, as it shows the nature of the discharge from one of the main water wheels; they were, at the time, carrying nearly full load; the capacity of the needle nozzle is about 50 per cent greater than that of the plain one, and the increased efficiency of the needle over the straight tip, which is the case here, is readily seen in this discharge. On the side of the straight tip, much water is passing the buckets, under great velocity, while on the near side the discharge from the wheel with the needle nozzle is comparatively quiet and lacking force.

The governors are operated by water under a pressure of 280 lb. It is carried through a 3-in. wrought iron pipe from a timber header some distance up the hillside; the header is supplied from a nearby spring.

There are two exciter sets, one on either side of the switchboard, and each consists of a 4-pole, 45-kw., 125-volt direct-current generator, connected on one side to an overhung water wheel and to a 50-h.p. induction motor on the other. The water wheel has a cast iron housing and is equipped with a needle regulating nozzle. The water wheel equipment was furnished by the Pelton Water Wheel Company.

The switchboard is in four panels and is similar in style and equipment to those at Volta. The generator switches are oil-immersed and are mounted on the rear of the board. The fourth panel contains the control for the induction motors. There is also an auxiliary lighting panel controlling all lighting circuits to the buildings, cottages, etc.

The transformer building is divided longitudinally by a masonry wall into two sections. In the side nearest the power house are the 22,000-volt Pacific Electric & Manufacturing Co. oil switches, Westinghouse low equivalent lightning arresters and static interrupters, for two outgoing circuits. One of these circuits is the tie line to Volta, while the other takes a northerly direction, and connects to the 22,000-volt network at De la Mar.

The lines are equipped with this system's standard pole-top, disconnecting switches and horn-gap lightning arresters. There is in addition, in the De la Mar line, for added safety in case the interior apparatus should fail, a Bowie "Kilarc" air-break, circuit-breaker. This is one of the first examples of this type of switch, and being the initial installation, took its name from this plant. It is equipped with solenoid release and can be electrically tripped from the switchboard. In the view of the power house, it is seen on the extreme left.

On the further side of the transformer building the compartment is divided into three parts; the center space is smaller than the other two and contains a spare transformer. In each of the other spaces, there are three 625-kw., oil-immersed, air-cooled transformers mounted on low trucks, six in all. They are wound on the primary side for 2200 volts and on the secondary for 22,000. In the wall, opposite each transformer, is a door through which they may be moved. Parallel to the building is a track over which a low flat-car may be pushed opposite to any door and thus facilitate the changing or moving of the transformers should it become necessary.

With the addition of the enormous storage of Tamarack Valley to this system the capacity of this plant, which was limited by the low water flow in Cow Creek, may be doubled. In anticipation of this added capacity, it is proposed to extend the present power

house building toward the creek to afford space for one 3000-kw. generating unit. This machinery is now in course of manufacture. The generator will be similar in type and make to those at the Inskip plant, while the water wheel will consist of a single runner, equipped with a ball-joint, deflecting needle nozzle, and to be supplied by the Abner Doble Company. Three 1500-kw. Westinghouse transformers will be installed and the high tension equipment will be changed to operate at a potential of 66,000 volts.

The power house buildings are surrounded and protected from the eroding action of the creek, during times of freshet, by a heavy rubble retaining wall. Across the creek is a comfortable club house and dwelling for the operators.

Transmission Lines.

There are two distinct types of transmission lines which have been adopted as standard for this system. The older is for 22,000-volt circuits and the later for 66,000. The first type follows closely standard practice of a decade past and consists of 30 or 35 ft. round cedar poles, No. 1 Provo, 40,000-volt triple petticoat glass insulators and solid copper wire. The higher voltage lines are mounted as a rule on 35-ft. round cedar poles, but with greater spacing between them, 14½-in., four-part Locke and Thomas porcelain insulators over steel, porcelain bushed pins and both copper and aluminum wire.

Except for a few places near towns roads are not followed by the transmission lines and the country, as a rule, is rough. Notwithstanding, the patrolmen cover the main lines every day and those of lesser importance at least once each week; it is necessary for them to ride on horseback.

Following is a list of the various lines with the general specifications; these may be readily located on the map of the system:

Substations.

There are in all 34 substations on this system, which vary more or less in design and capacity, due to the many different kinds of service which they render. These stations are at the following points: Redding, Iron Mountain, Horsetown, Germantown, Keswick, Kennet, De la Mar, Ingot, Copper City, Gladstone Mine, Brunswick Mine, Millville, Niagara Mine, Lappin Mine, Balakallala Mine, Mammoth Mine, Shasta, Manton, Gold Diggings, Coram, Baird, Proberta, Heroult, Anderson, Cottonwood, Red Bluff, Tehama, Molinos, Vina, Chico, Orland, Corning, Willows and Hamilton. Aside from these are the transformer equipments of various mines and smelters.

At Palo Cedro, which is on the Volta to Redding line, at a distance from Volta of 21.5 miles and from Redding of 6.7 miles, is a switching station in the 22,000-volt circuit. From this station radiate the lines extending to the south, through Red Bluff to Willows and to the north to De la Mar. At Redding the substation is placed in a group with the city water works. At Red Bluff it is operated in conjunction with the gas works and at Willows with the water works of the town.

The water works at Redding is owned by the company and the supply is pumped from wells driven in a gravel channel near the Sacramento river and delivered into a reservoir placed on a hill above the town.

In all towns, the company maintains well equipped offices and stores where supplies are carried.

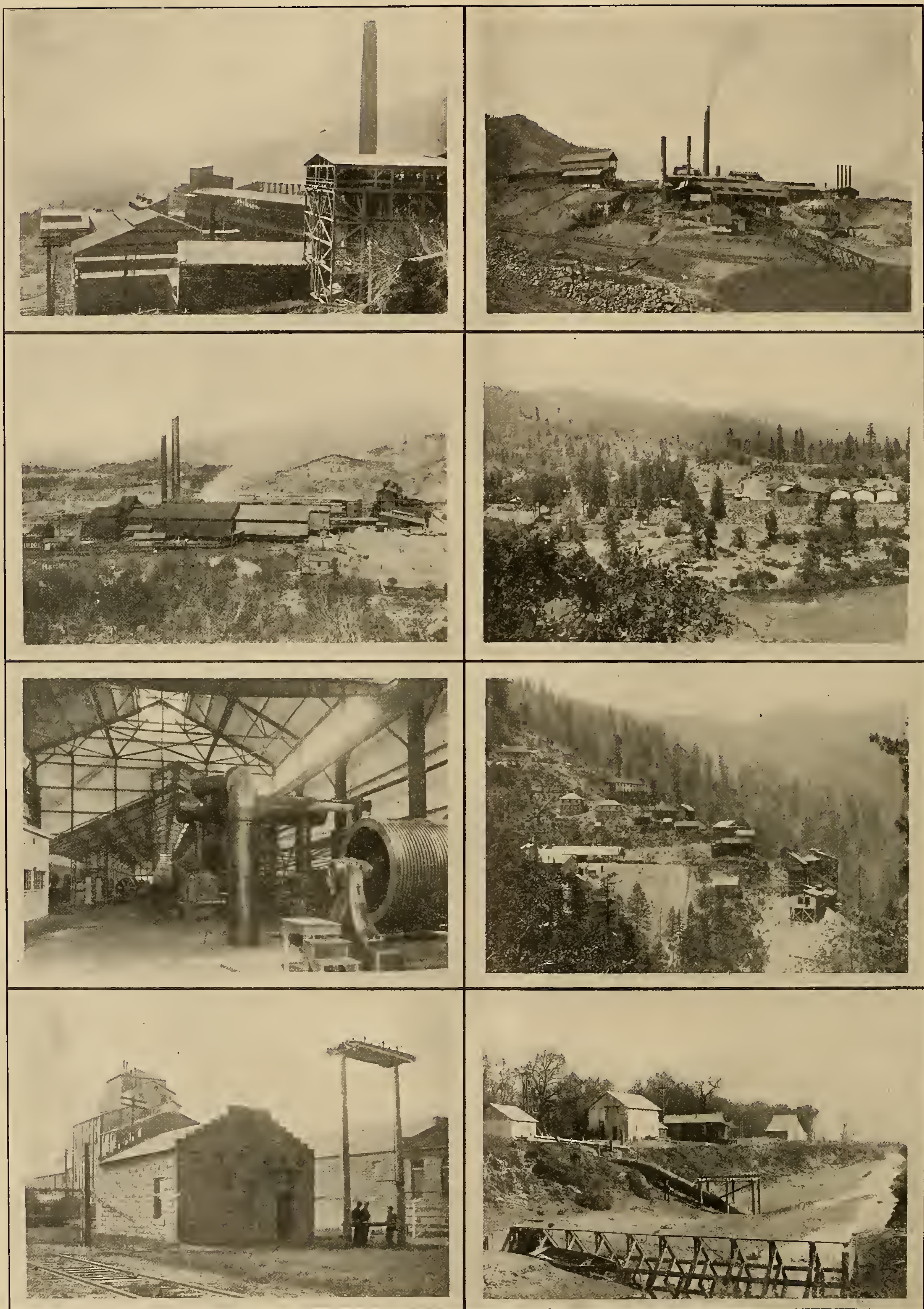
At both Redding and Red Bluff the company owns the gas works; in the former place the equipment consists of two holders with a total capacity of 42,000 cu. ft., while at the latter place there are three holders, the first with a capacity of 10,000 and the other two having capacities of 5000 cu. ft. each. Gas is made by

TRANSMISSION LINES AND GENERAL SPECIFICATIONS

	Voltage.	Length.	No. Circuits.	Size Conductor.	Insulators.	Poles.	Spans.
Volta P. H. to Redding	22,000	28.2	2C.	4Cu.	Provo.	30 ft.	125 ft.
Redding to Iron Mountain	22,000	11.7	2C.	4Cu.	Provo.	30 ft.	125 ft.
Redding to Horsetown	22,000	9.04	2C.	4Cu.	Provo.	30 ft.	125 ft.
Keswick to Mt. Shasta Mine	22,000	4.24	1C.	4Cu.	Provo.	30 ft.	125 ft.
Keswick to Balakallala Jct.	22,000	12.75	1C.	4Cu.	Provo.	30 ft.	125 ft.
Keswick to Caribou and Sugar Lk	22,000	8.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Balakallala to Brunswick M.	22,000	21.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Balakallala Jct. to De La Mar	22,000	14.5	1C.	4Cu.	Provo.	30 ft.	125 ft.
Kilarc to De La Mar	22,000	19.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Kilarc to Volta	22,000	15.6	1C.	4Cu.	Provo.	35 ft.	225 ft.
Palo Cedro to De La Mar	22,000	18.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Palo Cedro to Red Bluff	22,000	29.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Red Bluff to Tehama	22,000	12.4	1C.	4Cu.	Provo.	30 ft.	125 ft.
Tehama to Willows	22,000	36.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Orland to Hamilton	22,000	15.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Copley to Old Diggings	22,000	4.	1C.	4Cu.	Provo.	30 ft.	125 ft.
Tehama to Vina	2,200	10.	1C.	4Cu.	glass	30 ft.	125 ft.
Palo Cedro to Mammoth	66,000	16.	1C.	1Cu.	4-pt. Por.	35 ft.	225 ft.
Volta to Palo Cedro	66,000	21.5	1C.	1Cu.	4-pt. Por.	30 ft.	125 ft.
Volta to Chico	66,000	70.	1C.	1 Cu. & 00Al.	4-pt. Por.	35 ft.	200 ft.
Volta to South P. H.	66,000	5.	1C.	1 Cu. & 00Al.	4-pt. Por.	35 ft.	225 ft.
South P. H. to Inskip P. H	66,000	5.	1C.	1 Cu. & 00Al.	4-pt. Por.	35 ft.	225 ft.
Nord to Hamilton	66,000	8.5	1C.	1 Cu. & 00Al.	4-pt. Por.	35 ft.	225 ft.

Total length of 22,000 volt lines .... 258.43 miles
Total length of 66,000 volt lines .... 126.00 miles

384.43 miles



INDUSTRIAL PLANTS SUPPLIED BY NORTHERN CALIFORNIA POWER CO., CONS.

(1) Balakalala Smelter. (2) Mammoth Smelter. (3) Interior Mammoth Smelter. (4) Sub-Station and Beet Sugar Factory at Hamilton. (5) Bully Hill Smelter. (6) Heroult Electric Smelter. (7) Mammoth Mine. (8) Pumping Plant of the Central Irrigation Canal.

Lowe crude-oil apparatus and the daily capacity in each place is 100,000 cu. ft.

Current is supplied for loads of every conceivable nature. At Chico it is supplied directly from the transmission line and sold at a flat rate to the Pacific Gas & Electric Company; the substation at this point contains merely the necessary line switches and instruments for measuring the power supply.

The following list gives the various points of supply and the nature of the service:

		H.P.
Anderson	light and power	
Baird	light and power	
Balakalala Mine	power	700
Brunswick Mine	power	40
Bully Hill	light and power	
Bully Hill Smelter	power	700
California Copper Mine	power	
Central Canal	power	575
Copper City	light and power	
Coram	light and power	
Coram: Balakalala Smelter	power	1,550
Corning	light and power	
Cottonwood	light and power	
Crown Deep Mine	power	125
Germantown	light and power	
Gladstone Mine	power	350
Gold Leaf	light and power	
Hamilton City	light and power	
Heroult Smelter	power	3.000
Horsetown, dredge	power	250
Ingot	light and power	
Ingot; Afterthought Smelter	power	400
Ingot; Afterthought Mine	power	130
Kennet	light and power	
Kennet Mammoth Smelter and Mine	power	4,200
Keswick	light and power	
Keswick; Mt. Copper Co.	power	1,200
Lappin Mine	power	80
Little Nellie Mine	power	125
Los Molinos	light and power	
Mad Ox Mine	power	
Magra Summit Mine	power	150
Mammoth Mine	power	
Manton	light and power	
Millville	light and power	
Mountain Copper Co. Mine	power	400
Mt. Shasta Mine	power	
Orland	light and power	
Proberta, alfalfa mill	power	450
Red Bluff, gas works	light and power	
Redding, gas works, water works	light and power	300
Quartz Hill Mine	power	150
Reid Mine	power	250
Sugar Loaf Mine	power	
Tehama	light and power	
Summit Mine	power	50
Shingletown	light and power	
Uncle Sam Mine	power	50
Vina	light and power	
Washington Mine	power	150
Willows, water works	light and power	60

In San Francisco are the administrative offices, where are the headquarters of the president, Mr. H. H. Noble, who personally accompanied the writer in his quest for material for this article and Mr. Edward Whaley, the secretary and purchasing agent, who also rendered valuable assistance. At Redding is the office of the general superintendent, Mr. E. V. D. Johnson; at Volta, of Mr. H. A. Tedford, electrical superintendent, and at Kilarc of Mr. G. R. Milford, sueprintendent of the Kilarc division. All of these gentlemen and many others have rendered much valuable data and the broad knowledge exhibited of their various branches of work, together with the unquestioned interest in the welfare of the system, which seems to be universal, is a tribute to the management and a source of satisfaction to the owners of the company.

ENGINEERING DATA OF NORTHERN CALIFORNIA POWER COMPANY'S SYSTEM.

Hydraulic:

Watersheds: Battle Creek, Cow Creek, Burney Creek.

Storage Reservoirs: Manzanita Lake.
North Battle Creek Res. (building).
Tamarack Res. (building).
Macomber Lake.
Buckhorn Lake.
Cow Creek Res.

Ditches: 40 Miles.

Tunnels: 2.34 Miles.

Power Stations:

Volta: 3 750 kw. generators.
1 2,000 kw. generator.
1 2,400 kw. generator.
9 500 kw. 500/22,000v transformers.
6 875 kw. 2,200/66,000v transformers.
3 1,250 kw. 22,000/66,000v transformers.
Static hydraulic head, 1,196 and 1,250 ft.
Total capacity output, 8,500 h.p.

South: 1 4,000 kw. generator.
3 1,500 kw. 6,600/66,000v transformers.
Static hydraulic head, 515 ft.
Total capacity output, 6,500 h.p.

Inskip: 1 4,000 kw. generator.
1 2,000 kw. generator.
6 1,500 kw. 6,600/66,000v transformers.
Static hydraulic head, 370 ft.
Total capacity output, 8,000 h.p.

Power Stations:

Kilarc: 2 1,500 kw. generators.
1 3,000 kw. generator (to be installed).
6 625 kw. 2,200/22,000v transformers.
3 1,500 kw. 2,200/66,000 transformers (to be installed).
Static hydraulic head, 1,200 ft.
Present capacity output, 4,000 h.p.
Future capacity output, 8,000 h.p.

Coleman: (Under construction, ready for operation June, 1911.)
3 4,000 kw. generators.
3 4,000 kw. three-phase, 6,600/66,000v transformers.
Static hydraulic head, 479 ft.
Total capacity output, 16,000 h.p.

Total present generating capacity, 27,000 h.p.
Total generating capacity (1911), 47,000 h.p.

Transmission Lines:

22,000 volt lines, 258.43 miles.
66,000 volt lines, 126.00 miles.

Total............384.43 miles.

Sub-Stations:

Operated by the company, 34.
Towns supplied, 28.

ANNUAL REPORT OF CITY ELECTRICIAN OF LOS ANGELES.

Some interesting facts are contained in the annual report of Mr. R. H. Manahan, city electrician of Los Angeles, Cal., recently filed with the board of public works of that city. The report covers the year ended June 30, 1910, and shows that the cost of electric street lighting in Los Angeles was $272,133.48. Of this amount, $216,605.53 was paid by the city for street arc lighting, while property owners paid $22,372.80 for special ornamental street lighting. The number of permits issued for electrical construction and repair work was 14,782, representing an increase of 32 per cent over the year before.

Mr. Manahan calls attention to the fact that more assistance is needed in the department of electrical inspection, which has to cover a territory of 100 sq. miles. He recommends that all wires should be enclosed in conduit in the fire district and in all public buildings and large apartment houses outside of the fire district. Attention is called to the fact that petitions have been presented for the ornamental lighting of Pico street, from Main street to Vermont avenue, 1.97 miles; Seventh street, from Boyle street to Hoover street, 4.13 miles; Sixth street, from Main street to Alameda street, 0.81 mile; Third street from Main street to Hill street, 0.21 mile, and First street, from Hill street to Chicago street, 2.10 miles. The present mileage of this type of street lighting is 6.8 miles, and with the extensions enumerated above the total will be about 16 miles of special ornamental street lighting.

During the year the report shows that 221 street arc lamps were installed, making a total of 2804 lamps in the old city proper. There are still a number of streets in Los Angeles that are poorly lighted, and Mr. Manahan recommends that at least 400 additional street lamps be placed in position during the present fiscal year. These new lamps will cover, as far as possible, the unlighted sections in the recent annexations as well as the city proper. The city electrician notes that Hollywood is lighted throughout by 50-watt tungsten lamps under a five-year contract and he suggests a revision of this contract by which the city may secure a more advantageous rate, at the same time assuring the company a fair return on its investment.

Examination for draftsman is announced by the United States Civil Service Commission on August 24-25, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of marine-engine draftsman, $1800 per annum, Office of the Chief of Engineers, War Department. Applicants must have had at least ten years' experience. Graduation in mechanical engineering will be considered equivalent to four years of this required experience. Experience in dipper and hydraulic dredge design is desirable.

A test case of the recently enacted Los Angeles ordinance fixing the rates for electric current at 7 cents instead of 9 cents is to be made by the electric light and power companies of that city who have allowed two employees to be sent to jail in default of bonds for alleged violation of the law.

UNDERGROUND REAL ESTATE.

The recent announcement by the San Francisco assessor that he had decided to make a radical change in the system of assessing the underground conduits, cables, mains and manholes of gas and electric lighting corporations, etc., leads up through an interesting chain of possibilities. Heretofore such underground holdings of public service corporations have been assessed at about one-half the cost of their construction. It is understood that under the assessor's future policy they will no longer be classed as personal property but as real estate.

The practical, although perhaps unforeseen, effect of this change of the mains from personal to real property will be to create a vested right in or shift the title to those portions of the street thus occupied from the municipality to the corporations themselves. But many of those interested have not realized that when the public-service corporations become possessed of vested rights in the ground occupied by their mains the said property might possibly be subject to condemnation by the municipality under certain circumstances that may arise shortly. This may have the effect of compelling the city to condemn its rights of way for its high-pressure water system or other public uses. It shifts the burden of cost of the necessary changes in underground in the city streets for the accommodation of the high-pressure system, now under consideration, from the public-service corporations to the municipality.

The fact that there are twenty-two lines of mains and conduits for water, gas and electric lighting purposes in Market Street and that other downtown streets are also well filled with mains makes the subject one of immediate concern to both the corporations and the city authorities. It may cause greatly increased assessments for some of the corporations on their underground equipment. It would also enable these concerns, it is held, to increase their capitalizations proportionately and entitle them to issue additional bonds on their extensive, though narrow strips of downtown real estate. It has been ascertained by competent engineers that the expense of shifting the corporations' mains and conduits permanently to make way for the city's new high-pressure water mains will be immense and will fall very heavily on several of the lighting companies.

No provision has been made by the city to relieve the public-service corporations of these heavy expenditures. In case the corporations' attorneys prove that a title has been acquired by the companies assessed for alleged real estate values on the ground occupied by their mains, it seems to follow logically that the city's rights of way across their pipe-lines would have to be secured by condemnation. In that event damage suits might possibly follow and the municipality might have to pay the cost of the alterations as well as the damages. The outcome of the threatened situation will be awaited with great interest by all concerned.

Synthesis of ammonia from nitrogen and hydrogen has been accomplished in Germany by subjecting these elements to a temperature of 500 degrees under a pressure of about 200 atmospheres. The ammonia is removed either by liquefaction or by the use of catalytic absorbents such as osmium or uranium.

CURVE FOR THE DETERMINATION OF THE POWER FACTOR OF A THREE-PHASE LOAD.

BY W. M. SHEPARD.

By means of the curve shown below the power factor of a three-phase load may be determined from two single-phase wattmeters or watthour meters or from one polyphase wattmeter or watthour meter.

The curve is derived from the formula given on p. 55 of the "Watthour Meter," by Shepard & Jones,

as reprinted from the Journal of Electricity, Power & Gas, March 19, 1910.

R is the ratio of the readings of the two single-phase meters or of the two elements of the polyphase meter (disconnecting one element and then the other.)

If P′ is the smaller of these readings and P″ the larger, $R = \frac{P'}{P''}$

Where one meter or one element of the polyphase meter registers backwards P′ is taken as (—).

MANY NEW ELECTRIC LINES IN KOBE DISTRICT, JAPAN.

As a further stage in the development of transportation facilities in Japan, Consul David F. Wilber tells of the opening of four new trolley lines in the Kobe district:

The four miles of the Kobe Electric Company's line (18 miles contemplated), opened in April, cost $1,500,000 gold. The dynamos, rails, poles, and air brakes are American, the running gear and machinery of cars English, and the woodwork of cars and overhead wires Japanese make. The fare is 4½ cents, and the earnings for the first two weeks averaged $850 per day, and expenses $230 per day.

The Minomo-Arima Electric Railway Company's 18-mile line to mountain summer resorts, opened on March 15, cost $2,000,000. The rails, dynamos, boilers, and running gear and machinery of cars are American, the woodwork of cars and overhead wires Japanese make. The fare is 19 cents and the 30 cars are earning $940 per day.

The Keihan Electric Railway, 28 miles long, was opened on April 15, connecting the important cities of Osaka and Kyoto, and running through other large towns. The $3,500,000 capital was expended and a debt of $1,250,000 contracted. The materials nearly all came from England, though the overhead wires came from the United States, while the woodwork of the cars was made in Japan. The fare for the entire distance is 20 cents, and the daily earnings for the first two weeks averaged $1,500. The company's 30 cars, with an 8-minute schedule, will be supplmented by 20 cars with a 5-minute schedule. The Keishin Electric Railway, from Kyoto to Otsu, and the Uji Electric Railway, from Fushimi to Uji, now building, will connect with this line.

The Hyogo Electric Railway opened its first section —from Hyogo to Suma—on March 15; it will extend 12 miles along the shore of the Inland Sea to Akashi. The material has chiefly come from the United States, the woodwork of the cars and the overhead wires being made in Japan.

The new electric railways just opened having paralleled the track of the Government Steam Railway from Kyoto, through Osaka and Kobe, as far as Suma, on the Inland Sea, the authorities of the Imperial Government Railways, in order to meet the competition, have lowered the third-class fare for this section of the line to the same amount as that charged by the electric railway companies. They are also going to spend a large sum of money in track improvement and will put on more and faster trains.

PROPOSED MEXICAN LAW GOVERNING USE OF STREAMS.

By orders of the President of the Republic, the Minister of Fomento has just sent to the Chamber of Deputies a bill which is intended to govern the distribution of waters under federal jurisdiction, and which was drafted some months ago by the water bureau of the Department.

As stated in the communication which supports this bill, its object is to define the extent of the general jurisdiction, limiting it to the policing and regulation of the use of the waters, specifying the offenses which are not provided for under the Penal Code, as well as the penalties which are to be applied to such offenses.

The bill indicates the intention that, either by private initiative or by direct action of the Government, the works tending to favor and secure the development of the national products shall be realized as soon as possible, and thus avoid the importation of the staple articles which frequently occurs in our country through the total or partial loss of our crops.

The works for the timely utilization of the waters are not only advantageous to the nation, but they also more especially benefit each one of the States of the Republic through which such waters run. For centuries past these waters have crossed those same States without rendering any service, and have lost themselves in the ocean; and it is now time for the National Government to supervise and regulate the proper use of one of the principal sources of wealth with which our country has been favored.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.
DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS
Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Electric Shows

From time to time mention has been made in these columns of an electrical exposition to be held in San Francisco. Unforseen difficulties have delayed the opening of this show for nearly a year, but authoritative announcement is now made that all will be in readiness by September 17, the show to be open for eight consecutive days thereafter. In October a similar show is to be held in Denver.

These shows are a valuable means for popularizing the use of electrical apparatus. Many exhibitors are to make a special display of the application of electricity to the home. Aside from the healthful lighting that it has made possible, the electric current now offers a practical solution to the servant question. Cooking with electric heat becomes a pleasure and incidentally the food thus prepared is better. Electric clothes-washers, electric irons, vacuum cleaners and sewing machines are a boon to the hard-working housekeeper. When such devices can be seen in actual operation the public is soon educated to their use.

The educational value of these exhibits is useful in removing some of the distrust that is naturally associated with electricity because it is unknown. Electrical men throughout the country should put forth every endeavor to support these two Western shows in particular as they are the first large-scale attempts at introducing electric consuming devices to the Western people.

Power Utilization

A hydroelectric power development, like a railroad, is one of the few business enterprises that is started before there is even a demand for the commodity that it supplies. At its inception the tributary territory is frequently but sparsely settled and the inhabitants apparently have but little use for electricity. But experience has shown that a valuable class of settlers are attracted by cheap and convenient power. They create new industries which in turn demand more power and so the cycle continues like "the farmer who buys more land to raise more corn to feed more hogs." Many a system which was originally built to supply power to a distant market, subsequently finds a more profitable load nearby.

Ten years ago it required indomitable courage for the Northern California Power Company to build a plant in Shasta county, where a few prospect holes constituted the only evidence of the great copper mines to be developed and a few large ranches were the forerunners of the thousands of little farms into which they were to be sub-divided. Today these mines supply ore to four large smelters requiring sixty-eight hundred horsepower; in fact these smelters have poured forth such volumes of smoke as to damage the surrounding vegetation and make necessary the further aid of electricity in suppressing the noxious fumes. It is within this period also that alluvial gold has been found in the river bottoms that may be worked by electrically-driven dredges.

Farmers, likewise, were not slow to realize that water for irrigation can be pumped electrically and that their chores can be quickly and easily done by electric motors. One alfalfa mill needs four hundred and fifty horse-power to prepare food for cattle. The electric railways now grid-ironing the northern part of California give rapid transportation and incidentally use a part of the current generated by this company.

The most significant item, however, is a matter of three thousand horsepower supplied to the Heroult iron smelter where electric heat is converting ore to pig. The ore deposits are close to the power plant and the current is bought cheaply enough to make this project commercially feasible.

Heretofore the engineer's attention has been more largely devoted to the problems of power generation than to those of its utilization. But now each month sees some new method of applying electric power to the needs of the men who are the beneficiaries of those daring pioneers who risked millions of dollars in developing this country's latent resources.

PERSONALS.

John R. Cole has returned to San Francisco from the Yosemite Valley.

A. M. Hunt is making a two weeks' trip through the Pacific Northwest.

Anson H. Rees has been appointed buyer for the Ventura County Power Company, Oxnard, Calif.

E. R. Lilienthal and A. D. Schindler, of the Northern Electric Company, have been visiting at Sacramento.

J. H. Leary has been appointed assistant manager of the Central California Traction Company, of Stockton, Cal.

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, is spending a few weeks in the Northwest.

A. C. Sprout, electrical engineer, is again at his office in the Crocker Building, San Francisco, after a month's illness.

Leopold Michaels, of the Metropolitan Light & Power Company, has returned to San Francisco after a trip to Europe.

Leon Bly, secretary of the Sierra Irrigation, Light and Power Company, was recently at San Francisco from Red Bluff.

C. L. Cory returned to his San Francisco office last Wednesday after a trip extending through Arizona and New Mexico.

Douglas Lindsay, chief engineer of the power plant in the Humboldt Bank Building, has returned from his annual vacation trip.

K. G. Dunn, of Hunt, Mirk & Co., has gone to Idaho on business connected with the Westinghouse Machine Company's agency.

Paul Shoup, assistant general manager of electric lines for the Southern Pacific, has returned to San Francisco after an Eastern tour.

E. C. Jones, chief engineer of the gas department of the Pacific Gas & Electric Company, including eighteen gas plants, will shortly leave for the East.

E. C. Johnson, heretofore with the engineering department of the Southern Pacific Railroad, has been appointed chief engineer of the Los Angeles Pacific Company of Los Angeles, Calif.

Delos A. Chappell, who has charge of the work of the Hydroelectric Company, and several other new California and Nevada developments, recently spent several days at San Francisco.

F. V. Lee, formerly assistant general manager of the Pacific Gas & Electric Company, is sojourning with his family at Manchester, England, his old home. He will remain abroad about a year.

A. C. Balch, vice-president and general manager of the Pacific Light & Power Company, of Los Angeles, was a San Francisco visitor during the past week. He is contemplating a European trip in the near future.

Seton Porter of the firm of Sanderson & Porter, is visiting the relief dam which has just been completed for the Sierra & San Francisco Power Company on one of the upper forks of the Stanislaus river. The water stands at a depth of 132 feet behind the dam.

H. P. Pitts, who was at one time at the head of the commercial department of the Pacific Gas & Electric Company, and was purchasing agent for the Great Western Power Company, during the past three years, has again joined the staff of the former corporation.

Joseph Mayo, who was connected with the management of the Contra Costa Electric Light & Power Company, is now superintendent of that distributing system covering Antioch, Martinez and other towns, for the Pacific Gas & Electric Company, the new owner.

Edward Boening, who was formerly attached to the superintendent's office of the Western Union Telegraph Company at San Francisco, has been assigned to take charge of the company's office at Seattle, Wash., succeeding District Superintendent R. T. Reid, who has resigned.

C. H. Gaunt, the new general superintendent of the Pacific division of the Western Union Telegraph Company, returned to his San Francisco headquarters last Monday after an inspection tour of the offices at Seattle, Portland and Tacoma. He was accompanied on the trip by I. N. Miller, Jr., his assistant.

NEW CATALOGUES.

"Brill Magazine" for July, 1910, in addition to a number of illustrated descriptions of new types of cars, contains an interesting account of special conditions at Tokyo, Japan.

Bulletin No. 4756, issued by the General Electric Company, gives a graphic description of the ventilation of horizontal steam turbine alternators, which will be instructive as well as interesting to those connected in any way with the operation of these machines.

Bulletin No. 4751, recently issued by the General Electric Company, is devoted to various types of that company's induction motor. The bulletin contains illustrations and descriptions of the design and construction of the skeleton frame motor of different sizes, and describes a vertical motor which can be furnished when this form is advantageous.

Catalogue 105 from Agutter-Griswold Company of Seattle, Wash., is a handsomely printed and bound list of electrical material manufactured by this company. It contains 126 pages and is divided into 5 sections, dealing respectively with knife switches, panel boards, steel cabinets, switchboards and miscellaneous material such as slate, copper, brass and insulating material.

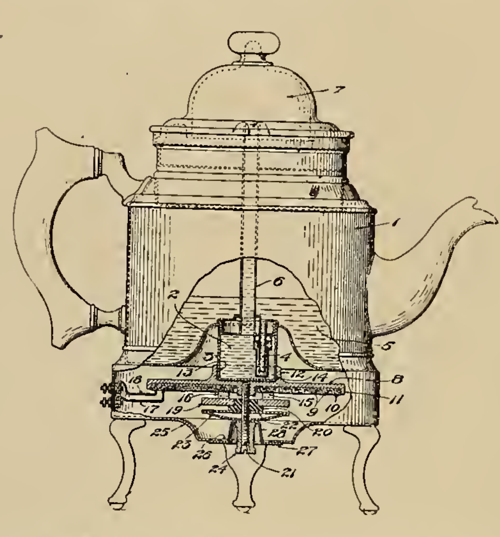
Publication No. 3968, recently issued by the General Electric Company, on electric cooking apparatus for hotels and restaurants, should be of considerable interest to managers of hotels and restaurants, due to the fact that it deals with a subject which is being given a constantly increasing amount of attention by hotel and restaurant people. The publication illustrates and describes various appliances designed especially for hotel and restaurant use, for example, broilers, roasting and baking ovens, toasters, plate warmers, stock kettles, automatic egg boilers, etc.

A bulletin on GE Mazda 400 and 500-watt incandescent lamps for standard lighting service has been issued by the General Electric Company, which describes that Company's large Mazda lamps for standard lighting service. These lamps are suitable for large stores, armories, factories, etc., and are economical substitutes for other building units of high candle-power and clusters of small lamps of low candle-power. The bulletin contains data regarding cost of lamps and service at various voltages, and illustrates also the fixtures suitable for use in connection with these lamps.

The General Electric Company recently issued a publicaton devoted to general illumination by its intensified arc lamp. This publication, No. 4742, contains a description and and illustrations in considerable detail of a lamp which the company has designed for general illuminating purposes, which is simple, mechanically, and reliable in operation. The principal characteristics of the lamp, however, are its high efficiency and the daylight quality of its light. The publication contains a color chart showing the illuminating values of various forms of lighting as compared with day light. This chart compares the incandescent, Welsbach, Nernst and the arc, with day light.

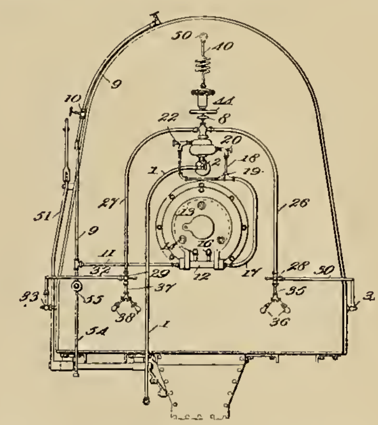
PATENTS

965.449. Electrically-Heated Apparatus. Horace B. Gale, Natick, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. In an electrically heated apparatus, the combination with the part to be heated, of a metal receptacle having electric heating means in heat-conductive relation thereto,



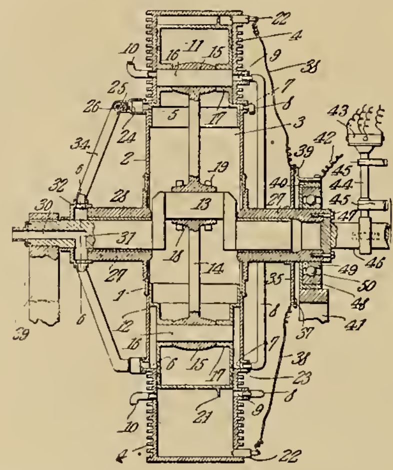
and provided with a recess in its upper side approximately fitting the said part to be heated, and a heat conducting body fusible at a lower temperature than said part of said receptacle filling the space between them, for maintaining conditions of maximum heat conduction.

965,719. Oil-Burner. Arthur H. Light, Los Angeles, Cal. In an oil burner the combination of an oil supply; a steam supply; an atomizing chamber in which said steam is tangentially delivered and in which said oil is delivered in a



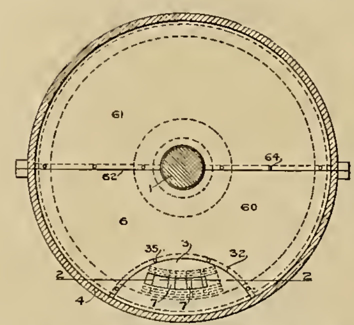
thin film; a second atomizing chamber; a second steam supply for said second chamber; a connection between said chambers; a pipe leading from said second chamber to the furnace; and automatic means for controlling the amount of oil delivered to said first mentioned chamber by the pressure of the steam generated by said furnace.

965,385. Revolving Gas-Engine. George Haniquet, Long Beach, Cal. A rotary two cycle gas engine comprising a fixed crank shaft having a feeding bore in one end, a plurality of compound cylinders mounted to rotate around said crank shaft and each provided with diametrically opposite ports in both its diameters, pistons in said cylinders connected with the crank shaft, conduits forming an independent connection between each cylinder and the feeding bore, and a series of independent conduits connecting the alternate cylinders and



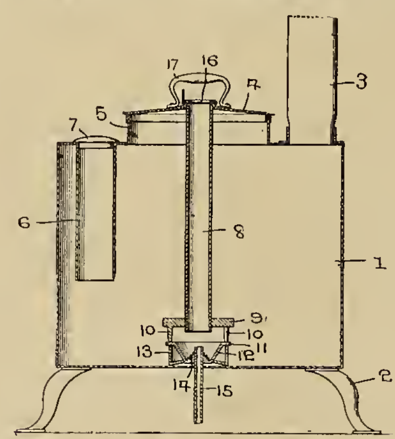
leading from the larger diameter of one cylinder to the smaller diameter of the companion cylinder.

965,412. Steam-Turbine. Rudolph Schlatter, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. In a turbine, a diaphragm discontinuous at one part of its



periphery, and a nozzle section co-acting at said part of said diaphragm entirely at surfaces of revolution having a common axis.

965,407. Burner. David L. Reese, Redlands, Cal. A burner comprising a bowl-shaped member, a spiral channel extending upwardly from the periphery of the base of said member, a fuel supply pipe extending vertically through the



shaped member, an arc supply pipe terminating above said bowl-shaped member, and a deflector supported on the upper portion of said bowl-shaped member.

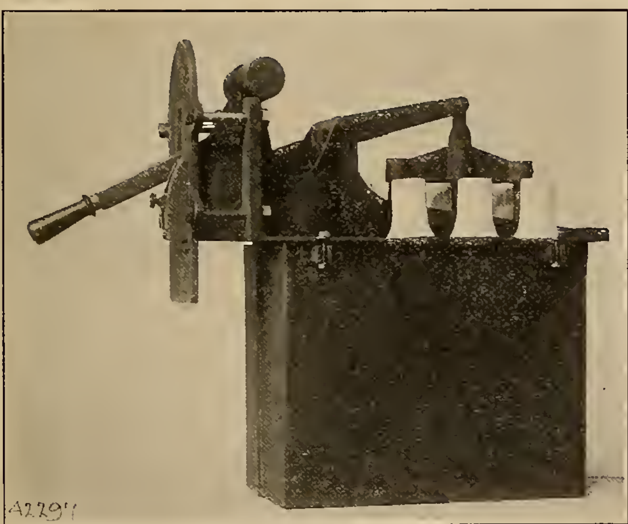
INDUSTRIAL

TYPE H OIL CIRCUIT BREAKERS FOR ALTERNATING CURRENT CIRCUITS,

Realizing the need for a simple, reliable and, at the same time, inexpensive oil circuit-breaker for use in general industrial application ultilizing low potentials, the Westinghouse Electric & Manufacturing Company, a few years ago, placed on the market the now well-known type H oil circuit breaker, designed for potentials not exceeding 600 volts and with a current carrying capacity of from 10 to 300 amperes. This breaker was designed for mounting on a wall or post or any location convenient to the operator.

So successful have been the principles of operation embodied in the type H circuit-breaker, that it has been decided to extend this line to include breakers of the same current carrying capacity adapted for switchboard mounting, and for use on alternating current circuits having potentials as high as 2500 volts.

The new type in addition to embodying all the distinguishing features of the old 600 volt type, also possesses several inherent advantages, the most prominent of which are the inverse time element and the "full automatic overload" release attachments.



Type H Oil Circuit Breaker.

The type H oil circuit breakers are equipped with overload release trip coils suspended from the frame of the breaker, immersed in oil and connected directly in series with the line. The plungers of these trip coils are retarded in their action by a device giving the circuit-breaker an inverse time element. The time element introduced is sufficient to permit the use of this type of circuit breaker for motor starting service. The mechanism is known as "full automatic overload," that is, it is equipped with a device that renders it impossible to close the breaker or to hold it in the closed position while a continued abnormal overload condition or a short circuit exists on the line. The time limit device referred to above, permits the breaker to be closed under a momentary overload or rush of current such as is incident to starting an induction motor or throwing the controller to "running" position.

An under voltage release atachment which opens the breaker whenever the line voltage falls below a certain predetermined value can be supplied for these type H oil circuit-breakers. It consists of a magnet coil connected directly across the line for voltages not exceeding 600 and through potential transformers for voltages higher than 600. This coil is self-contained and is so designed that it may be attached to the breaker without any modification in the mechanism.

The 600-volt style has a single break to each pole, while in the 2500-volt style there are two upper and two lower contacts for each pole, thus securing a double break per pole. The contacts consist of cylindrical brass rods, the lower ones being backed up by individual spiral springs to insure good contact, and form the well known "butt" contact type. This method, familiar in the multiple unit system of control on heavy street railway equipments, has been adopted with great success in oil circuit breaker practice. It insures good contact always and prevents any possible failure due to eating away the contacts by continued arcing. The compression springs mentioned take up any wear that may occur and render the contacts self-aligning.

EMERGENCY ELECTRIC LIGHTS FOR SHIPS.

The steamship "Alabama" of the Goodrich Line, which runs between Chicago and Muskeegon, Mich., has recently installed an interesting system of emergency electric lights which is furnished with current from a storage battery.

These lights have been installed to provide illumination in the corridors and on stairways in case of an accident to the generating apparatus, or, in case of the sinking of the vessel, lights would be available to aid passengers in making their escape after the hull of the boat had sunk some distance in the water.

In order to provide illumination as long as possible in case the boat should sink, the battery has been placed at the highest point of one of the upper decks.

The storage battery in use is composed of 56 cells type ET "Chloride Accumulator" in glass jars, manufactured by The Electric Storage Battery Co., having a rated output of 4.5 amperes for 8 hours. This battery will supply current for 10 hours on one charge for 25 four candle-power 110-volt carbon lamps which are in use in this installation.

The battery is charged during the day, and at night after the generators stop running, the lights used on decks, in halls and stairways are supplied with current from the battery alone. This system provides a reliable source of lighting which is always available in case of accident.

Similar battery equipments installed on other boats for furnishing current for emergency electric lighting service are also extensively used for the operation of wireless telegraph apparatus.

ERRATA NOTICE.

The first line, second column, page 83, issue July 23, 1910 in article on "Witt Automatic Feed Water Regulator and Oil Burner Governor" is superfluous and should be omitted. The word "boiled" in the next line should be "boiler." Furthermore, it should be understood that this regulator is simple in construction and has but one wearing part. The entire device is external to the boiler.

TRADE NOTES.

The national convention of the Electrical Jobbers' Association will be held at Del Monte, California, in the spring of 1911.

G. E. Witt Co. of San Francisco has just received an order from Densmone-Stabler Refining Company of Los Angeles for four sets of their automatic oil burner governors and boiler feed regulators.

THE WESTERN ELECTRIC WATCH-CASE BATTERY GAUGE.

The No. 30 battery gauge recently developed and placed on the market by the Western Electric Company is a compact instrument for measuring accurately and efficiently the strength of telephone dry batteries used in connection with

Western Electric transmitters. It is designed for connection to three cells in series, duplicating conditions of the local battery subscribers' set. It contains apparatus for gauging current through two resistances, corresponding to high and low resistance transmitters.

The No. 30 gauge is in watch-case form, and the views which are shown herewith demonstrate the convenience of the arrangement. It contains no scale, but is designed

merely to show the point at which batteries should be put out of service. For the high resistance transmitter a mark above the arc on the face of the gauge is used to denote the cut-off point. This means that current from the three cells is being sent through 20 ohms resistance. The cut-off point is 140 milli-amperes, a point which conforms with the best telephone practice.

When the stem of the watch-case is depressed, 15 ohms resistance are removed, leaving only five. This produces the conditions of the low resistance transmitter, and the cut-off point, which is indicated below the arc, is 420 milli-amperes.

WILMETTE PUMPING STATION.

The drainage canal and incident works of the Sanitary District of Chicago has attracted the attention of engineers for several years. Of chief importance has been the method thus employed of securing a pure water supply for a city of this size. Previous to the beginning of this work the sewage of the entire city was discharged into the harbor directly, or through the Chicago and Calumet rivers. This condition of sewage pollution led to sever epidemics of typhoid fever and Chicago had an unenviable reputation for this disease. Long and serious study of conditions by both engineers and sanitarians led to the determination of the system finally adopted for removing the trouble.

This consisted in the construction of a canal, about 28 miles long, connecting the Chicago and Desplaines rivers, striking the latter near Lockport. By this means the direction of the flow of the Chicago River was reversed and the waters of Lake Michigan were used to dilute the sewage which later finds its way to the Mississippi River.

Upon the completion of the canal proper further safeguards were carried forward, first the building of an intercepting sewer along the lake shore on the south side of the city extending as far south as 87th Street and covering all that section included up to the Chicago River. At 39th Street a pumping station was built which not only handled the sewage collected by the intercepting sewer, but also took large quantities of water from Lake Michigan and discharged it with the sewage into the south branch of the river, thus tending to maintain a current which would keep it free from any dangerous or disagreeable condition.

This station contains four Allis-Chalmers centrifugal pumps for handling sewage and two screw pumps for taking the water from the lake. It has a total capacity of two billion one hundred million gallons (2,100,000,000) per twenty-four hours, which is the largest pumping capacity of any single plant in the world. After this was completed, work was started on what is known as the Lawrence Avenue Station which handles the sewage from the intercepting sewer along the north shore of the city and also takes water from Lake Michigan and discharges it into the north branch of the Chicago River.

Beside these projects already completed, the district now has under construction what is known as the north shore channel on which will be located the Wilmette Pumping Station. There is also in contemplation a plan for the reversal of flow in the Calumet River at the south of the city and when this is completed, together with certain sewage pumping stations which the city itself maintains, the entire shore front of Chicago and its immediate vicinity will be well protected.

The construction of the north shore channel is progressing quite rapidly now and probably within the course of the present year will be completed and in operation. This channel takes water from Lake Michigan near Wilmette and discharges it into the north branch of the Chicago River. From the Lake to Sheridan Road, a distance of about 400 ft., the water will flow by gravity. Here a viaduct carries this road across the canal channel, and built as a part of the viaduct and beneath it is the pumping station and a lock.

Beneath the center span of the bridge will be located the pumping station. This will consist of a motor room and transformer room each 29 feet by 54 feet inside dimensions. Four horizontal screw pumps each having a capacity of fifteen thousand cubic feet per minute against a head of 3 feet when running 75 r. p. m. will be installed. Each of these pumps will be driven by a 150 h.p., 3 phase, 60 cycle, 2300 volt induction motor. The pump runners will be located on the easterly side of the building with the shafts extended horizontally into the motor room. These pumps are similar in construction to others of the same character installed by Allis-Chalmers Company in the 39th Street and Lawrence Avenue stations.

NEWS NOTES

FINANCIAL.

ASHLAND, ORE.—Bids will be received up to August 2 by the city recorder for the purchase of $25,000 electric light bonds of this place.

KENDRICK, WASH.—The proposed bond issue to provide a fund of $10,000 for the purpose of installing an adequate water system has been defeated.

JACKSONVILLE, CAL.—The City Council has called an election for August 1 for the purpose of voting $30,000 bonds for the establishment of a gravity water system.

MODESTO, CAL.—The city will hold a bond election for municipal improvements. Sewer improvements, $65,000; water system, $15,000; street improvement, $10,000; fire department, $10,000.

MOUNTAIN HOME, IDAHO.—Electors of the village of Mountain Home, Elmore county, Idaho, will hold an election on the 17th of August for the purpose of submitting to the qualified electors the question of authorizing the issue of $48,000 of negotiable coupon bonds; interest at 6 per cent, due in 20 years.

PORTERVILLE, CAL.—A 500,000 gallon reservoir on Murry or Park hill and a pumping plant on the flat below, to be used in conjunction with the present plant has been decided upon at a consultation of the City Trustees. The voters of the city will be called upon this summer to approve about $50,000 in bonds to build the reservoir and put in the pumping plant.

INCORPORATIONS.

OROFINO, IDAHO.—The Clearwater Telephone & Telegraph Company has been incorporated for $40,000 by Samson Snyder.

SEATTLE, WASH.—The Sunset Falls Light & Power Company, capital $100,000, has been incorporated by J. A. Soderberg, 310 Alaska building; G. N. Miller and J. S. Jurey.

REDLANDS, CAL.—The Mill Creek Pipe Line & Reservoir Company has been incorporated by N. B. Hickley, J. M. Cole, J. H. Strait, J. M. L. Frink and W. H. Van Lenrein, with a capital stock of $50,000.

HEDGESVILLE, MONT.—The Montana Telephone Company has been incorporated by W. E. Ford et al, for $10,000. This company will take over the interests of the local company and a number of rural lines will be constructed.

ILLUMINATION.

HELENA, MONT.—Dr. C. E. Schroeder, and J. C. McCarthy have been granted a franchise for a gas plant in this city.

PASADENA, CAL.—A five-year contract has been signed with the Pacific Light & Power Company for the installation of a new tungsten power system of 550 lights.

JACKSON, CAL.—The natural flow of water getting short at the summit, the Pacific Gas & Electric Company will order the water turned out of Blue Lakes, Alpine county, for use to furnish power for the plant at Electra, this county. The lake supply will last about seven weeks.

SAN FRANCISCO, CAL.—An advance in wages of 25 cents per day has been granted the electrical workers in the employ of the Pacific Gas & Electric Company. The agreement has been signed here between the Pacific District Council of the Electrical Workers and the company. Under the new agreement outside electrical workers will receive $4.25 per day with time and a half overtime and $5 per day for foremen. The raise dates from June 1 of this year. All the outside electricians from San Francisco to Central California are benefitted by this new schedule and this means that 1000 men have received a wage raise. The new schedule adds $150,000 per year to the company's pay-roll.

TRANSMISSION.

ELK CITY, CAL.—C. S. Batchelder, superintendent at the South Fork mine, reports that a power plant is planned for the near future.

OROVILLE, CAL.—John A Hall of Plumas county and George H. Sparks of this city have filed a notice of the appropriation of 2000 inches of the waters of Coldwater creek below Buck's ranch, in Plumas county. The intention of the locators is to carry the waters of the ditch and pipe line a distance of about 650 feet from the point of diversion to the site of the proposed power plant.

BOCA, CAL.—A survey is now being made along the Truckee river in the vicinity of Boca for the construction of a power plant to cost $750,000. The Truckee river will be tapped above Boca, and a long tunnel through the mountain south of the river will be constructed to carry the water, which will empty back into the river about a mile below Boca, insuring over 10,000 horsepower to supply lights and power to Reno and other cities along the Truckee river.

SAN FRANCISCO, CAL.—The Sierra and San Francisco Power Company, allied with the United Railroads, has filed papers by which it appears that there has been a reclassification of its bonds. When the company was first organized it authorized a bonded indebtedness of $20,000,000. First mortgage bonds were authorized to the amount of $14,000,000 and second mortgage bonds in the sum of $6,000,000. The rearrangement places the first mortgage bonds at $10,500,000 and the second mortgage securities at $9,500,000. The total remains as before at $20,000,000.

THE DALLES, ORE.—The American Power & Light Company, the new holding concern organized last month to take over the properties of the Northwest Corporation located in Idaho and Oregon, has purchased the hydroelectric plant and distributing system of the Wasco Warehouse Milling Company, of The Dalles. The plant consists of a hydroelectric station on White river and transmission lines to Dufur and The Dalles, Ore. The energy is used for lighting and power, including the operation of the large flour mills of the Wasco company.

SPOKANE, WASH.—Five hundred thousand dollars will be expended by the Washington Power Company in tunneling under the Spokane river for about a quarter of a mile west from the upper falls in the business district of Spokane, where four water wheels of 1000 kw. capacity will be installed to generate 53,500 h.p. Work has been started by the Church & McCoy Company of St. Paul, which also has contracts to erect a three-section car barn to cover a block. The tunnel work is similar to that under Niagara Falls and presents the same engineering feats. "This method of utilizing the power of the Spokane river will give us a direct fall of 144 feet or about twice what we have at present by using the lower falls," said D. L. Huntington, president of the company. "It is impossible to give the entire estimated cost at this time, as this preliminary work on the shaft will have to be completed first to get at the real tunneling work. It is safe to say, however, that the cost will

be around $500,000, possibly more. We have set no specific time for completing the work, that depending largely upon the engineers after they have made their estimates when the first shaft is sunk. The work on this shaft will go right ahead." Three temporary compressed air drills, each of 250 horsepower, are in operation and will be supplemented by a compressor of 1200 cubic feet a minute. The working shaft of the tunnel, 10 by 20 feet, will be sunk 150 feet. There will be three compartments, two for elevators and one for the pipes and other stationary working equipment. From the bottom of the shaft the tunnel will be driven 1000 feet up and down the river, the western extreme terminating just below the lower falls now used by the power company. This tunnel will be 22 feet in height and 27 feet in width. The company also is surveying a route for a new power line from Post Falls, Idaho, to Newport, Wash., to supply light and power to Newport, Sandpoint and other cities in eastern Washington and northern Idaho.

TRANSPORTATION.

ALBANY, ORE.—The Albany & Interurban Electric Railway has been granted a franchise by the city council.

OREGON CITY, ORE.—G. Clarence Fields has announced his intention of constructing an electric railway from Oregon City through the Molalla valley.

SALT LAKE, UTAH.—An application for a franchise to run electric cars through the city has been made by the Salt Lake and Ogden Railway Company.

LOS ANGELES, CAL.—By a vote of 5 to 2 the City Council of Long Beach has decided to table the application of the Pacific Electric Railway for an entrance to the water front of the inner harbor.

LOS ANGELES, CAL.—Preparations for beginning of improvements by the Los Angeles-Pacific Comapny that will cost $5,000,000 or more, are complete. The first work will be the construction of a series of tunnels in the southwestern part of the city.

REDLANDS, CAL.—A. C. Denman Jr. of Redlands is at the head of a syndicate that will build an electric line starting at Chino and passing through Riverside, Allessandro valley to Perris, Lakeview, San Jacinto, Hemet, Elsinore, Corona and Chino. The central power plant is to be in that town.

GILROY, CAL.—Gilroy, as well as all of southern Santa Clara valley may expect interurban car service within a short time. It is the intention of the Peninsula Electric Railway managers to extend their line to this section when the work of completing the improvements between San Jose and San Francisco is ended.

CHEHALIS, WASH.—W. H. Allen & Co., engineers of this city, have helped to complete the survey for a $3,000,000 trolley line to be constructed between this place and Centralia and the various towns along the line to Randle, to be constructed by eastern capital. It is announced that work will begin this summer.

PASADENA, CAL.—Negotiations are pending between the Pasadena Rapid Transit Company and the North End Syndicate of Los Angeles property owners, whereby the syndicate is to furnish capital needed for the completion of a road building project and in return the road is to make its terminus at the Plaza in Los Angeles.

ROSWELL, N. M.—The Berendo Irrigated Farms Company, which acquired the Roswell electric light plant, will put in a modern electric street car system in this city. It is proposed to run out to the Bernendo irrigated farms, Roswell Country Club, Lea Lake Club, Hagerman orchards and farms at South Springs, five miles south of Roswell.

LOS ANGELES, CAL.—R. C. Gillis, president of the Los Angeles-Pacific Railway Company, has left for New York to complete financial arrangements for the construction of a double track subway electric road to Santa Monica, Ocean Park and Venice, and the construction of terminal and office building on Hill street, between Fourth and Fifth.

SACRAMENTO, CAL.—Representatives of the Northern Electric Company have made application for a franchise on Nineteenth street from C to K streets. It is the intention of the Northern Electric to run their interurban cars from their yards at Nineteenth and C, where the road enters the city to the depot of the Western Pacific Company, located in the block bounded by Nineteenth and Twentieth, J and K streets.

SOUTH PASADENA, CAL.—The Pacific Electric Railway Company has purchased three lots on the south side of Pasadena avenue on the north slope of the hill, south of the Cawston ostrich farm. It is understood that these lots were purchased for the purpose of putting a tunnel through the hill in order to lay street railway tracks from the Pacific old line to Lincoln Park station south through the hills to connect within a short time at a point near Bairdstown. This will shorten the distance to Pasadena.

LOS ANGELES, CAL.—The Pacific Electric Company has let the contract for the extension of the Covina line from Covina to San Dimas to Robert Sherer & Co. The Ontario and San Antonio Heights line from Pomona to Uplands via Claremont has settled its right of way difficulties and construction is being rushed on this line as well. This will mean that within 30 days there will be only the seven-mile gap between San Dimas and Pomona to be connected up before the Pacific Electric will be in a position to run through cars from Long Beach to Ontario.

SACRAMENTO, CAL.—Work of ballasting the Northern Electric Roadbed from Alamos, 20 miles north of here, to Sacramento, is in progress and will be finished before the wet weather commences. A new depot has been finished on the line at Thermalito, and work is in progress on a structure at Nicolaus. The construction of a new station at Live Oak will soon be commenced. The report of the Northern Electric to the State Board of Equalization shows the gross earnings of the railroad to have been $422,642 for the fiscal year. Because of the fact that for two months in 1909 the railroad was practically out of business because of damage done by the Feather, Yuba and Bear rivers to its bridges, this amount was slightly under the amount of earnings for the year previous.

ALAMEDA, CAL.—The work of converting the local steam roads of the Southern Pacific Company into a modern electric traction system is nearing completion. Practically all of the tracklaying has been finished and nearly all of the grading is done. Crossarm trolley poles have been installed and the large feed cables placed in position. The auxiliary electric power plant on the north side of the tidal canal near the Fruitvale avenue bridge is approaching completion, and the steel framework of the car house at Alameda point is in position. The ballasting of the double track roadbed on the extension loop from Eagle avenue and Broadway around the east end of the city to the eastern end of Encinal avenue is under way. The Eighth street crosstown line, which connects the north and south side lines, is completed and the double track extension in Lincoln avenue, west from Mastick station to a point on the south side line near Pacific avenue station is finished. On the Alameda mole the trolley wires and power cable will be carried on trusses extended between heavy iron poles. The trusses are already in position. Near the depot at the pier, where a number of switches are to be used, the trolley lines will be attached to wires suspended from tall wooden poles. No definite date has yet been fixed by the Southern Pacific management for the opening of the new electric system.

TELEPHONE AND TELEGRAPH.

PORT TOWNSEND, WASH.—The Independent Telephone Company has been awarded the contract for furnishing the three forts at this place with telephone service.

ASHLAND, ORE.—The Pacific States Telephone Company has bought out the Midway Telephone Company, operating between Ashland and Klamath Falls.

PENDLETON, ORE.—The Butter Creek telephone line has been taken over by the Eastern Oregon Independent Telephone Company. A. B. Thomas has been named as manager.

GRANDVIEW, WASH.—Harry Miles of the Benton Independent Telephone Company of Prosser has secured a 25-year franchise in this city. Material has been ordered for an exchange.

KLAMATH FALLS, ORE.—The Council has passed an ordinance granting to the Pacific Telephone & Telegraph Company a franchise to place poles and wires in the streets of this city.

PORTLAND, ORE.—Contracts have been let for 650 miles of copper-clad telephone wire for the proposed telephone system of the Oregon Trunk. The proposed system will cost about $50,000.

VANCOUVER, B. C.—The Pacific Telephone & Telegraph Company has been granted permission to excavate and lay an underground conduit for a trunk line for the new subway system of telephone lines.

NEW WESTMINSTER, B. C.—The British Columbia Telephone Company proposes to make extensive improvements in its system here next year, including an addition to its building and a new switch board.

LAS CRUCES, N. M.—The Tri-State Telephone Company, which has taken over the local telephone exchange, will soon begin the erection of a new plant, also the construction of a new system throughout the town.

MYRTLE CREEK, ORE.—The Council has passed an ordinance granting to the Myrtle Creek Telephone & Telegraph Company a franchise for installing within the town of Myrtle Creek, a system of telephone and telegraph wires.

PORTLAND, ORE.—$100,000 will be expended in this city and adjacent country within the next six months by the Pacific Telephone & Telegraph Company, which recently closed the deal for the purchase of the local telephone system from H. Gates.

BAKER CITY, ORE.—The contract for the re-building of the telephone line of the Sumpter valley railroad from Baker City to Sumpter has been let to Walter Kuhn, of the telephone company, and Jack London, of the electric light company. Work is to begin within a few days.

VALLEJO, CAL.—On Inspector Hanscom's return to Mare Island which will be some time in the fall, he will supervise the erection of a 300-foot wireless tower at the Mare Island yard and the installation of one of the most powerful wireless outfits that the Navy Department can manufacture.

SEATTLE, WASH.—C. H. Gaunt, general superintendent of the Pacific division of the Western Union Telegraph Company, announces that his company will build a new telegraph line from Seattle to Helena, Mont. Material for this line is now being assembled. Gaunt also made public the appointment of Edward Boening, formerly attached to the superintendent's office in San Francisco, to take charge of the Seattle office, succeeding District Superintendent R. T. Reid, whose resignation has already been presented.

SAN FRANCISCO, CAL.—The Home Telephone Companies of San Francisco and of Alameda counties, which have been operated under a common management, were announced recently to have merged their interests into the Bay Cities Home Telephone Company. The consolidation necessitated the taking up of the bond issues of the former two companies and the issuance of $20,000,000 of new securities. Attorney Frick says: "The mortgages held by the Union Trust Company on the properties of the local Home Company and by the Mercantile Trust Company on those of the Alameda company have been taken up and the Angle-California Trust Company has assumed the trusteeship of the new corporation and will underwrite a $20,000,000 bond issure retiring the others."

WATERWORKS.

RIVERSIDE, WASH.—F. J. Cummings will improve the streets and install a water system on Glenwood acre tracts this fall.

VALE, ORE.—The City Council has awarded to the American Light & Water Company the contract for the Vale water system. Engineer Bullock will have charge of the work.

TACOMA, WASH.—The Council has passed an ordinance providing for the construction of water mains in portions of Pacific avenue, South Fortieth street, South G street, Division lane, being Local Improvement District No. 558, the pipe ranging in size from 6 to 12 inches.

FALLON, NEV.—The City Council passed an ordinance authorizing the establishment, building and constructing a waterworks system for domestic use, manufacturing and fire protection for said city, to borrow the sum of $35,000 for this purpose and to issue and sell bonds of said city therefor.

ALAMEDA, CAL.—The negotiations between this city and the Bay Cities Water Company progressed another step July 25, when the acting city physician, H. A. Miller, reported that the analysis of samples of Bay Cities' water, made by the City Chemist, Miss Jessie Berry, showed that the water is good for all domestic purposes.

NEWARK, CAL.—For the last few days surveyors of the Bay Cities Water Company have been running a line through the Pacific Land Improvement Company's property near this place. Surveys have been made along the principal thoroughfares of Newark, and it is believed the new company plans to supply water to the residents of this district.

SAN FRANCISCO, CAL.—City Engineer Manson has filed a recommendation with the Board of Public Works that $3,000,000 of municipal water supply bonds be offered for sale, delivery to be made during the next two years, in order to provide funds for work. The amount of money named will, he states, enable the municipality to accomplish the following things: "To take up all, or an agreed portion, of the option on the Cherry Creek lands and rights; to construct the Lake Eleanor dam and canal; to construct the North Mountain power station, and to utilize the power therefore for construction and municipal purposes; to sell the water during the dry season under the terms of the grant of May 11, 1908, until the construction of conduits to the city." Regarding the Spring Valley property the city engineer says: "We are advised that extensive purchases of lands and rights in Livermore valley and of lands adjacent to the Sunol filter beds and the acquisition of the final rights in the Alameda creek drainage basin have been accomplished by the Spring Valley Company since the election of January 14, 1910. These acquisitions cover about 14,200 acres and have removed the possibility of litigation then under way or in prospect, and have involved an expenditure of about $1,700,000. More thorough explorations for the foundation for Calaveras dam are being made with a view of its early construction. The use of the water so stored is not definitely announced, but without an adequate increase in conduit capacity it would not be available to this city.

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JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3 1879

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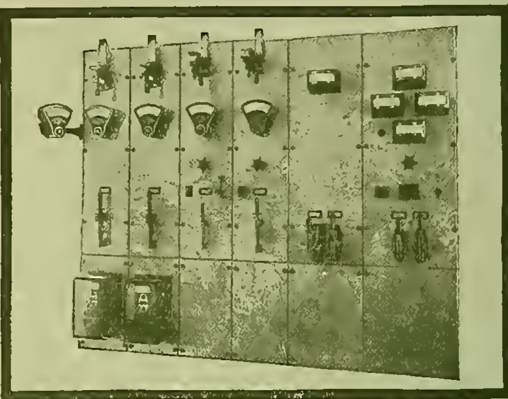

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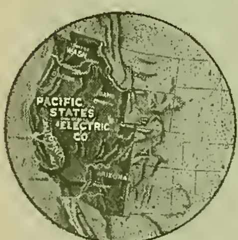

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JOURNAL OF ELECTRICITY
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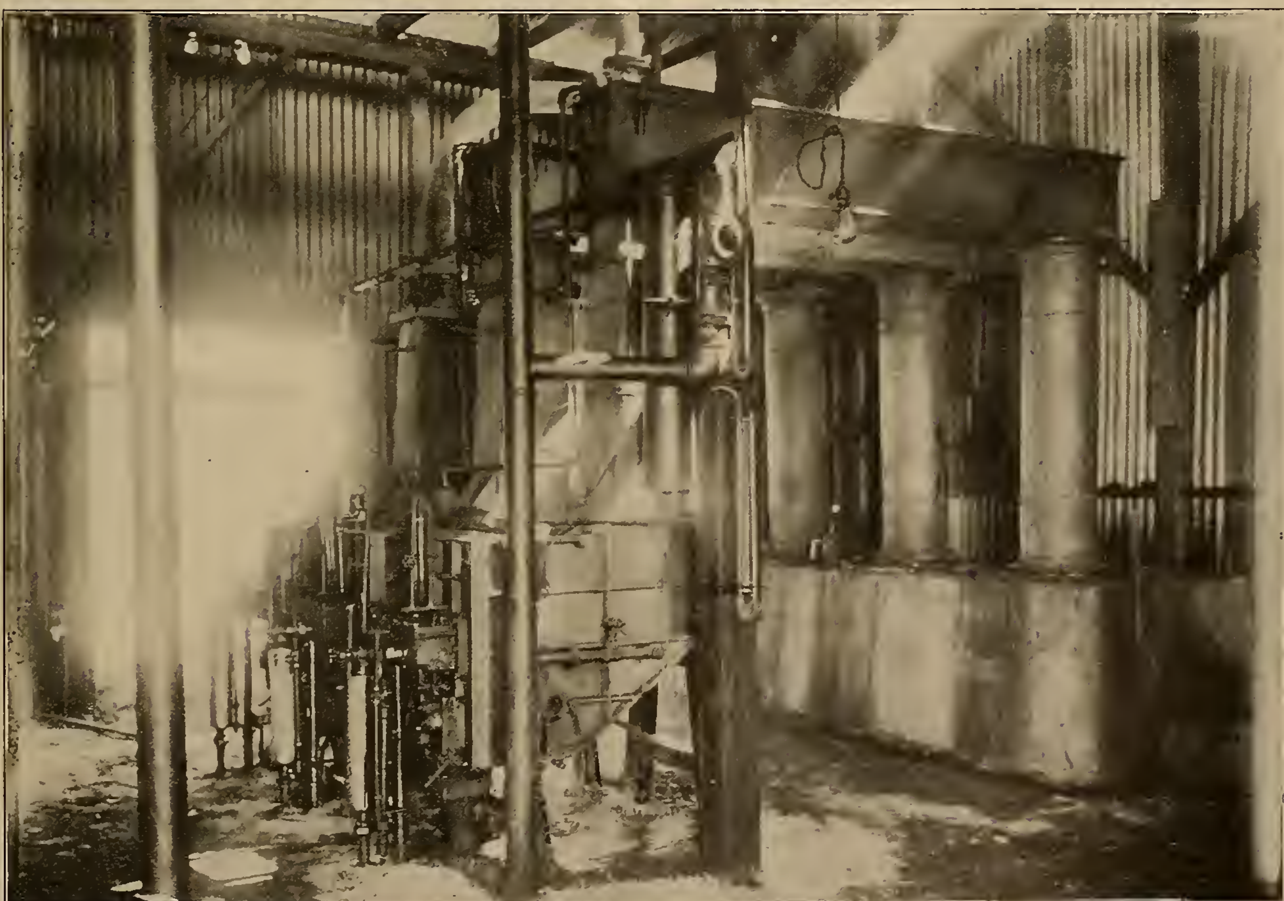
VOLUME XXV | SAN FRANCISCO, AUGUST 13, 1910. | NUMBER 7

THE INTERNAL COMBUSTION ENGINE VERSUS THE STEAM ENGINE ON THE PACIFIC COAST

BY WM. VAN DEN HEUVEL.

The internal combustion engine as a prime mover in power plant work on the Pacific Coast and adjoining territory is yet in its infancy compared with the development of this form of motive power in the East and in Europe. Analyzing the local situation we find a wide-spread prejudice that retards the installation of gas engine plants and favors the use of steam, even with its lower economy. As many put it, "The good, old reliable steam engine is good enough for me; we need power 24 hours per day and we cannot afford to have any shut-downs."



Amet-Ensign Oil-Gas Producer Installation at Yuma, Ariz.

It is the object of this article to roughly review the different kinds of fuel used with internal combustion engines and to analyze such features as become evident in a comparison with a steam plant of from 100 to 500 h.p. capacity. Most purchasers and a good many of the dealers in gas engines do not realize that with each gas engine installation there should be a thorough, complete, advance consideration of the load and conditions under which the gas engine is to operate. Though the number of adjustments left in the hands of the operator are few, they are, nevertheless, all the more important.

The writer has seen gas engines operating poorly

because of faulty timing of the ignition and of the valves; the governor was working only as an objectionable ornament; the cooling water in the jackets had no relation whatever to the average load carried, or even to full load. Engines which were sparking past the center had marks on the lay-shaft made by the factory, but creep and wear had made them obsolete. Such marks should be on the fly-wheel and the frame. Little has been said or done regarding the use that can be made of the 75 per cent of the total energy in the fuel fed to the engine that is lost in the cooling water for the jackets and in the exhaust gases. The popular opinion is, that, in most cases, arrangements to save this energy are only objectionable refinements yet in the experimental stage.

The amount of cooling water establishes the temperature of the cylinder walls and the form and efficiency of the explosion. It also affects the lubricating properties of the cylinder oil. As a result, cylinders and valves may foul quickly or again remain clean for a long period. A thermostat-valve in the water supply to the jackets would regulate the cooling water under variations in load and in the initial temperature of the cooling water. I am merely touching upon these points to emphasize the fact that gas engines, even while operating, require intelligent adjustment to give satisfactory operation and fuel-economy.

In a steam plant the power absorbed by the auxiliaries varies from 7 to as high as 30 per cent, depending upon the arrangement of the plant and the skill with which it is operated. Careful firing may decrease the fuel bill as much as 20 per cent, and yet, even with the most wasteful firing, and the number of steamplants with smokestacks coming under the classification of public nuisance is large, the continuous operation of the plant is not interrupted.

We may say that the gas engine plant, in its operation, is a check on itself and the operators. When the plant shows no or few interruptions of service, the owner may be reasonably sure that his plant is also being operated with the least amount of fuel necessary. No such conclusion can be drawn with the steam plant.

Far be it from the writer's intention to depreciate the operation and management of our good steam plants, particularly the large ones, but he wishes to emphasize that steam plant methods do not fit the gas engine plant, that one cannot get the benefits of the inherent low fuel consumption and continuous operation without necessary care and adjustments, also that with these adjustments once made in the properly installed gas engine plant continuous power is just as much of a possibility as in the steam plant.

It will be of interest to consider at some length some of the construction details of the gas engine plant. One of the most important advantages of the gas engine plant over the steam plant is the absence of large stand-by losses, in other words, the gas engine plant may be started and stopped at will, without incurring a loss incident to bringing up steam and to the stored and wasted energy in the boilers. Starting of the gas engine is usually affected by compressed air admitted to one or more of the main engine cylinders; air is furnished by an air-compressor outfit driven by a separate engine or motor. This compressor and the storage tanks should be of liberal size. Manufacturers tend to economize on this feature, saving perhaps $150, while the losses in time and fuel counted over the entire year mean a loss several times this amount.

Direct connection of the gas engine is often condemned, the argument being that the shock due to the explosion calls for flexible parts to take it up and it is held that the more flexible steam drive admits more readily of direct connection.

While this contention is correct in principle, the writer wishes to state that there are many instances in which it is carried too far; the problem of the selection of a suitable drive, comparing gas and steam engines, becomes entirely one of the design of the engine, especially of the flywheel. Many installations consisting of a belted engine could have been made direct connected by arranging from the outstart for heavier fly-wheels and a flexible coupling between the engine-shaft and the apparatus to be driven.

Particularly in pumping plants the prejudice against the direct connected gas engine has been carried too far. It is not necessary to use special engines to obtain the flywheel effect desired, as manufacturers can arrange this when duly informed as to the nature of the load to be carried. The difficulties of a large belt-drive together with its maintenance, cost and increased floor space make a consideration of each individual case well worth while.

The regulation of an engine, whether steam or gas engine, must satisfy two requirements. The first, the so called rotative regulation, is an expression giving the fluctuation of angular velocity during a full revolution. The better the rotative regulation the more uniform is the velocity of a point at the circumference of the fly-wheel under constant load. The weight of the fly-wheel, in conjunction with its dimensions and the number of revolutions at which it is operated, serves the purpose of counteracting the impulse due to steam admission or explosion of the mixture. The flywheel absorbs or gives up the energy due to the reciprocating motion of the piston, connecting rod and cross head, at the moment of reversal of the stroke. Changes of load instantaneous in nature, are also neutralized to a certain extent; however, here the governor begins to play its part. The more sensitive the governor, the more readily will it respond to changes of load, maintaining a uniform speed under variations of load within the so-called speed regulation of the engine. In comparisons of the regulation of steam and gas engines we must deal entirely with the rotative regulation, and we find that the designer of the gas engine must provide heavier and larger fly-wheels to obtain the same regulation as in the steam engine.

High rotative regulation is not always necessary; electric service has made high demands, however, in order to eliminate voltage fluctuations and also to prevent cross-currents in synchronizing generators and to overcome hunting as a result thereof. Any good gas engine manufacturer is now in a position to make guarantees on speed or rotative regulation, entirely meeting the requirements of electric service under the severest conditions.

The gasoline engine and the distillate engine are

essentially a compromise for the use of crude oil direct in the cylinders. Even though in many cases the reason for the use of these engines may be well founded, it still remains true that the direct use of the raw material, under elimination of cost for either partial or total refining, will always be considered the most desirable.

The economical production of power on a large scale, say above 100 h.p. occurs in the oil engine by burning the oil direct in the cylinders or in the producer gas engine, utilizing a gas made from crude oil in special apparatus provided for that purpose.

There are two practical oil engines now on the market, the Diesel engine, manufactured under a foreign license by Adolphus Busch of Saint Louis, Mo., and the oil engine of the De La Vergne Machine Co. of New York City. To my knowledge both manufacturers build engines in sizes not to exceed 300 h.p. and their engines have met with good success in the Eastern States. So far, neither firm has installed engines on the Pacific Coast. The writer has received proposals from of these firms, expressing their willingness to make guarantees on performances with California crude oil. Little can be said in an article of this kind, dealing with established facts only, what the future of these engines will be on our coast. The engines are constructed in a first-class manner by highly reputed builders who will undoubtedly exhaust all means to overcome the difficulties incident to the direct use of California asphaltum base oil in the engine cylinders.

Natural gas, usually of a heating value of about 900-1000 B.t.u. per cu. ft., is found in a number of localities throughout California, and is particularly suited for use in gas engines. Invariably, the development of the natural gas flows is restricted by the risk that the flow may stop or diminish and thus make the engine-installation useless. The measure of risk assumed in making a natural gas installation would be reduced by the installation of oil-gas producers at the outstart or whenever the yield of the gas wells would make desirable an additional gas supply. Natural gas and producer gas may be mixed in any proportion and this would occur by diffusion in the gas holder which would be a part of the installation. The gas engine can be made to fit either gas by a change of the compression carried.

An engine that is to work on both natural and producer gas should be designed to meet the requirements of the producer gas. Thus all dimensions, including the weight of the fly-wheel, would be ample or rather too large for operation on natural gas. The compression can easily be changed by the introduction of shimming pieces in the connecting rod, thus moving backward the piston and reducing the compression space.

The gas-engine operating on illuminating gas works less efficiently than any other gas-engine of the same type and size. The large percentage of hydrogen contained in the gas causes premature combustion at the compression that corresponds to the explosive pressure for the best result in economy. A large part of the cost of illuminating gas is due to the process of cleaning and washing to which it is put for lighting purposes and we may say that the gas engine will operate as well with a gas less clean.

The only gas engine installation of magnitude, operated on oil-gas was the Martin plant of the Pacific Gas & Electric Co., San Francisco. The gas used was practically an illuminating gas and the percentage of hydrogen by volume contained in the gas made at various times varied from 60 per cent to about 40 per cent. All the reports on the operation of this plant seem to indicate that premature combustion has been one of the serious obstacles. The cause for this may have been in the presence of too large an amount of hydrogen, though it has also been found that larger percentages of hydrogen may be used satisfactorily, provided that the compression chamber is constructed without sharp corners, that the valve-ports are properly rounded and that the ignition devices are placed at the proper point in the combustion-chamber. Even with the scant knowledge available of the construction details of this plant, the writer considers unfair a comparison of it with the large steam turbine plant, in a manner as presented by Mr. A. M. Hunt in an article read before the American Institute of Electrical Engineers at San Francisco. If it were possible, through presence of data on large oil producer and gas engine plants, to make a comparison at this present date, we might safely say that only such oil-gas installations will offer serious competition for the steam-turbine plant as require no more attention for the producers than a first-class boiler plant, preferably less. The holder should be only large enough to operate the plant at full load for, say no longer than 10 minutes. This would call for a producer fit to operate continuously. To properly compete an oil-gas installation should manufacture a gas that would be fit for use in the engines without danger of premature explosion or that would not be so variable in its properties as to make it impossible for the governor of the engines to follow up the fluctuations and give good regulation.

Producer gas manufactured from crude oil has been the nightmare and aim of many inventors; lack of knowledge of the chemical phenomena or of design of the producer and washing apparatus or again failure to grasp the physical and mechanical requirements that go to make a successful, commercial plant have been the obstacles in most cases. Oil-gas has been made in Germany, Russia and America for a number of years. We find mostly the so called retort process used whereby the crude oil is heated in a closed vessel and thus broken down into the constituents of the gas. Most processes are a combination of this retort process and of the water-gas process, the latter being the familiar reduction process of manufacturing carbon monoxide gas from carbonic acid gas by leading the latter over incandescent carbon. All these processes are intermittent in their nature; the gas-maker manipulates constantly and at regular intervals the various valves for oil, air and steam, alternating thereby a series of gas-makes and blasts. The latter are necessary to reestablish the temperatures necessary to conduct the process, also, to prevent injurious accumulations in the path of the gases as well as in the retort of lamp-black and tar that might interfere with the continuous operation of the producer.

In order to eliminate the constant manipulation of valves and constant attention of the operator, other producers have been devised. To the writer's knowledge, only two of these types of producers have been in actual operation, namely the Amet-Ensign and the Nix-Frost producers.

To go into the detail construction and operation of producers is not the object of this article. The writer, however, has had considerable personal experience with the Amet-Ensign producer in several places, particularly the government installation at Yuma, Ariz., where he made tests for the purpose of acceptance of the plant. With this process a fixed gas is made of an approximate heating value of 200 B.t.u. per cu. ft. On the basis of an economy of the engine equivalent to a consumption of 10,000 B.t.u. per brake h.p. per hour. This means an hourly consumption of 50 cu. ft. of gas per brake h.p.

The economies obtained in plants using oil-gas is high, averaging about 7 brake h.p. per gallon of oil per hour. While in some cases it has been demonstrated that this figure may be exceeded, it may be considered to represent the present state of the art. Economy in the oil-gas producer plant is not as much dependent upon the size of the plant as is the case with steam-plants, the economy mentioned above being realized in all plants above and including 100 h.p.

Steam-plants in actual operation do well when producing 3.5 brake h.p. per gallon of oil per hour fired under the boilers. Test reports published by the U. S. Geological Survey during the last few years show such figures and owners of steam-plants below 300 h.p., as well as of a good many of a larger capacity, know from their own records that they cannot do any better in operation from month to month. Continuing the comparison of the steam and the gas engine plants, experience has shown that a producer plant does not require any more attention than a boiler plant, even less, but if we assume that the number of operators is the same, then the comparison results in a balance of the higher first cost of the gas engine plant on the one side against the larger fuel consumption of the steam-plant on the other. Allowing for the different types of plants, varying with the work that the plant is to perform, the statement may be made that the cost of the gas engine plant may be as much as double that of the steam plant before it will offset the saving in fuel made each year in the gas engine plant.

To illustrate this statement, we may take a 300 h.p. plant operating at 60 per cent load-factor, 24 hours per day during the entire year. The total power produced will be 157,000 h.p. hours or the yearly fuel consumption 10,700 bbl., assuming an economy of 3.5 brake h.p. per gallon. The gas-engine plant with an economy of 7 brake h.p. per gallon will consume half this amount or 5350 bbl., costing, putting the price very low, $2675. Against this saving we must balance the larger cost of the gas engine plant. Assuming that the investor pays 7 per cent for his money and that he writes off on the books for depreciation of the plant each year 7 per cent of the total cost, then 14 per cent must represent $2675 or in other words the surplus cost of the gas engine plant must be $18,000. Again, supposing for the sake of simplicity of comparison, that the first cost of the steam plant installed amounts to $18,000, which would be $60 per h.p., a rather low figure, then the cost of the gas engine plant would have to be $36,000 in order to obtain the same yearly operating expense for the two types of plants. The average gas engine plant does not, by any means, cost twice as much as the average steam plant; the excess cost generally amounts to about 30 per cent and it becomes evident that big savings may be affected.

The lost energy of the gas engine becomes available in two forms and amounts to approximately 75 per cent of the energy in the fuel consumed. The energy lost through the jacket-water is available at a temperature of about 160 degrees F., that through the exhaust gases at about 600-1000 degrees F. The number of uses to which this energy may be put is large, much larger than with the steam plant which gives up its lost energy through the exhaust steam at the temperature of steam at nearly atmospheric pressure or about 220-230 degrees F. When utilizing the lost energy in the steam plant, the economy of the engine, run non-condensing, is very low and when attempting to better this economy by condensing, the lost energy is presented to us in the cooling water at the still lower temperature of about 110 degrees F. Generally, it is desirable to use the lost energy at as high a temperature as possible and therefor the gas engine offers a larger field of application.

A large number of auxiliaries for gas engine plants have been placed on the market, but here, even more than with the steam-plant, one should be careful in the selection of apparatus best suited for the application of the waste heat, in particular with a view on the probable load on the plant from day to day.

The introduction of the internal combustion engine into plants for office buildings will be possible only with careful considerations of the above nature. The same must be said of plants for laundries and for various factories where hot water or the heating of substances in driers ,hot-rooms or otherwise forms an important item. In plants where the requirements for heating exceed the amount of heat available from the lost energy in the gas engine, the old auxiliary heater with an oil-burner constitutes a simple and effective means to supply the lacking heat independent from the performance or load of the main engine. This is an important economical feature, for do we seldom see installations using exhaust steam from engines where the load is occasionally insufficient to provide the required amount of steam for steam heating and where live steam is introduced by means of a reduction valve from the main steam line and thus converted into steam of low pressure with accompanying unnecessary large losses.

California, with its large oil deposits, and under the present activity in oil-production and transportation, is facing a problem in the economical transport of the oil. The present method using large direct-acting steam pumps is indeed one whereby economy is not given much consideration. The gas producer and the gas engine will offer an opportunity for some true conservation work in the oil fields, going hand in hand with the practical application of the lost energy of the gas engine to the heating of the oil to a degree desirable

for minimum friction in the pipe-lines versus loss in valuable volatiles caused by excessive heating.

In all considerations presented in this article the reciprocating steam-engine has been referred to, not the steam-turbine simply because on this coast the steam-turbine has asserted itself more particularly in the larger plants, because of the high economies realized in such and not obtainable in the smaller units, also on account of the simplicity of operation and compactness of plant lay-out. It cannot be stated at the present date, in how far the large gas-engine plant will rival the large steam-turbine plant; so far, no gas-engine plant has been installed, embodying all the high attainments of the gas-producer and gas-engine professions.

UTILIZING WASTE HEAT FROM GAS ENGINE PLANTS.[1]

BY JOHN T. FAIG.

Two sources of great heat waste occur in internal combustion engines, the jacket water and the exhaust. This waste is so common that there is danger of losing sight of its importance. The amount of heat so lost varies in different engines, but is nearly always three times as great as the amount converted into work in the cylinder.

Not only is the heat of the jacket water lost in most cases, but its removal entails considerable expense; that is, the cost of the jacket water itself. There are, it is true, some few installations where the jacket water is used for heating or industrial purposes, but these are merely exceptions to the general run of plants.

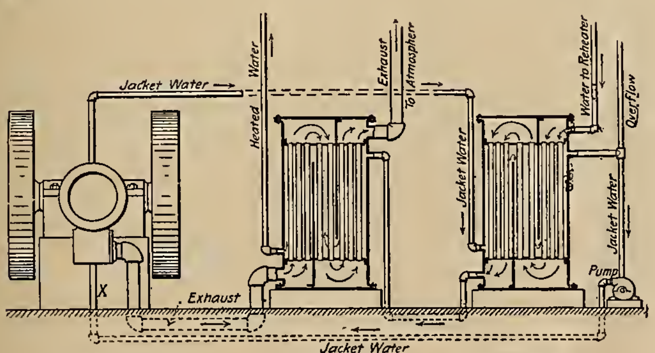


Fig. 1. Proposed Method of Utilizing Waste Heat in Jacket Water and Exhaust from Gas Engines.

The development of auxiliaries that will utilize the heat of the jacket water and exhaust gases must keep pace with the development of internal combustion engines if these engines are to compete with steam engines where the exhaust is used. Where hot water for heating or industrial purposes is required the utilization of most of this waste heat presents no great difficulty. Fig. 1 represents an engines with two simple heat interchanges, one using the jacket water and the other the exhaust gases. The jacket water is used over and over. The water to be heated must have sufficient pressure to overcome friction of passage through the interchangers.

The same idea may be expressed in many different designs. There is no reason why one interchanger should not be placed on top of the other, or the two combined in the same shell. One form of interchanger has recently been put upon the market.

Some firms use part of the heat of the exhaust for vaporization of water for the producer. The writer has given some attention to the utilization of waste heat from producer power plants and has designed a plant utilizing practically all of the heat in the coal, except the inevitable losses of hot ash, mechanical friction and radiation, all of which may be reduced to very small percentages of the total.

The interchanges may be of the simplest construction, since all pressures are small and temperatures comparatively low, the highest being that of the exhaust gases, from 600° to 1,000°. A thermostatic valve could be installed to automatically admit cold water from the city mains should the temperature rise too high. This might occur if for any reason the circulation of the water being heated should be stopped. The exhaust gas interchanger should form an excellent muffler. The exhaust pipe between the engine and interchanger should be covered to reduce heat loss to maintain a reasonable temperature near the engine and to prevent burnt hands.

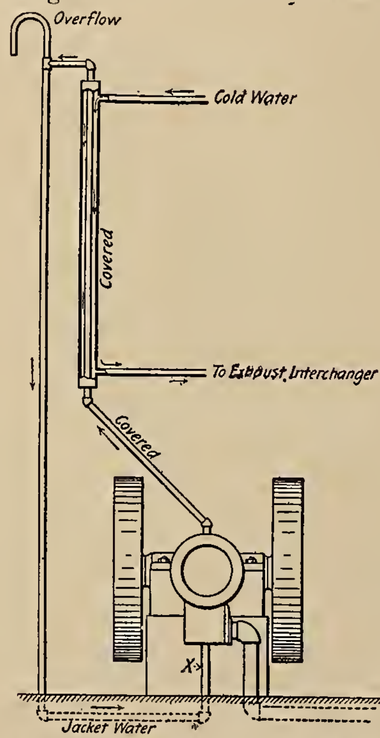


Fig. 2. Alternative Method of Utilizing Waste Heat in Jacket Water from Gas Engines.

Fig. 2 shows an interchanger using the jacket water of an internal combustion engine to heat water. The jacket water is used over and over. The heated water passes to an exhaust interchanger, similar to that in Fig. 1, to be further heated. This arrangement does away with the necessity for a circulating pump in the jacket water line. A thermostat controls the admission of cold water to the jacket water line and will operate if for any reason the interchanger does not absorb sufficient heat from the jacket water. The jacket water interchanger may be secured against a wall overhead to save space if there is sufficient head room. The height which will give the proper circulation for a given engine could probably be determined only by trial.

[1] Extract from paper read at a July, 1910, meeting of the National Gas and Gasoline Trades Association.

CALCULATION OF GAS ANALYSIS.

BY R. F. CHEVALIER.

Having already described the combination of oxygen with the various elements in the oil, and the combining weights of each, the application of the results obtainable from the flue gas analysis will now be illustrated.

For complete combustion, a pound of carbon requires 2.67 pounds of oxygen, equal to a volume of 32 feet at 60 degrees F. When the products of the combination (carbon dioxide) cool, they occupy the same volume as the oxygen did originally. Oxygen is mixed with the nitrogen in the air in the proportion of 20.91 to 79.09. After complete combustion, the volume of carbon dioxide will be in the same proportion to the nitrogen as that of the oxygen originally. Therefore with complete combustion of carbon with no excess of air, the volumetric analysis of the gases is

Carbon dioxide	CO_2	= 20.91%
Carbon monoxide	CO	= 0.0 %
Oxygen	O	= 0.0 %
Nitrogen	N	= 79.09%

When air is in excess of the amount required to supply the oxygen needed, the sum of the volumes of carbon dioxide and oxygen is the same as that of the oxygen before combustion.

In a fuel containing hydrogen, the percentage of nitrogen in the flue gases is apparently increased. This is due to the fact that the nitrogen accompanying the oxygen required for combustion with the hydrogen remains in a gaseous form while the products of the combination of hydrogen and oxygen (H_2O or steam) condense at the temperature that the analysis is made Oil fuel contains from 11 per cent to 13 per cent of hydrogen. Therefore the percentage in volume of nitrogen would be increased, and that of carbon dioxide would be correspondingly decreased in the composition of the flue gases of this fuel.

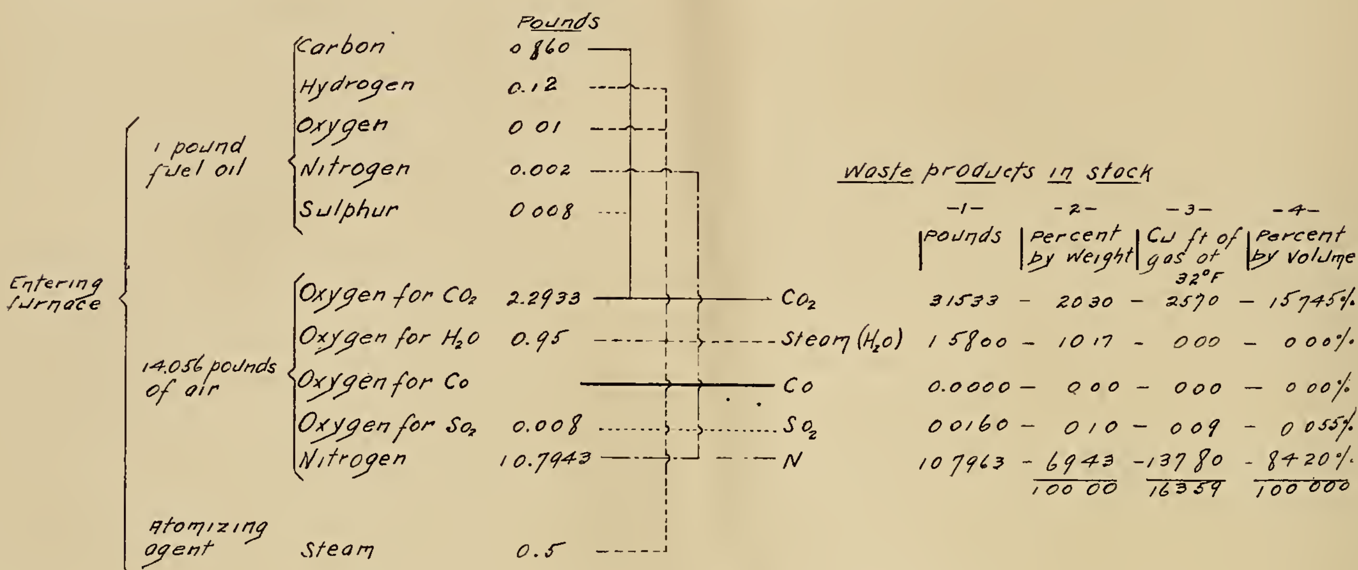
On referring to the "Tabular view of furnace combustion of one pound of oil," the results in the last column show that the maximum amount of carbon dioxide by volume found in waste gases from the average oil fuel is 15.75 per cent.

Column 3 is calculated by dividing column 1 by the weight of one cubic foot of gas. The density and weights of gases at atmospheric pressure will be found in table No. 6.

To determine the ratio of air supplied per pound of oil to the amount theoretically required, use is made of the following formula,

$$\frac{N}{N - 3.782\ O}$$

which is derived as follows:



Tabular View of Furnace Combustion of One Pound of Oil.

The nitrogen in the flue gas is the total amount that entered the furnace with the oxygen of the air. The oxygen was supplied with the air, but was not used. Nitrogen accompanied the oxygen by 3.782 times the volume of the latter. If N — 3.782 O represents the nitrogen entering with the air actually required for combustion, then

$$\frac{N}{N - 3.782\ O} = \text{the ratio of the}$$

air supplied to that actually required. Subtracting 1.0 gives the excess air in per cent.

Heat loss in flue gases is equal to the weight of the gas per pound of combustible, times the specific heat of the gases, times the difference of temperature of the escaping gases and that of the air entering the furnace, the formula of which is as follows:

$$L = 0.24\ W\ (T - t)$$

where

L = B. t. u. lost per pound of fuel.
W = Weight of flue gases in lbs. per pound of fuel.
T = Temperature of flue gases.
t = Temperature of atmosphere.
0.24 is the specific heat of the flue gases.

Where an analysis by weight is required, it can be found from the volumetric analysis, by multiplying the percentages by volume by the molecular weight of the

gas and dividing by the sum of all the products. The quotient will then be the percentage by weight.

We will assume that an average of the analysis of gases from a furnace show carbon dioxide 12.6 per cent; oxygen 4.2 per cent; and no carbon monoxide. The nitrogen, the other constituent of the gas is found by difference, i. e.:

$$100 - (12.6 + 4.2) = 83.2\%$$

The completed results will then read:

CO_2 — 12.6%
O — 4.2%
CO — 0.0%
N — 83.2%

Total....100.0%

The ratio of air supplied to that required would be

$$\frac{N}{N - 3.782\ O}$$

substituting

$$\frac{83.2}{83.2 - (3.782 \times 4.2)} =$$

$$\frac{83.2}{67.7} = 1.228 = \text{ratio of air supply.}$$

$1.228 - 1. = .228$ or 22.8% excess air.

In table No. 7 is shown the method of converting an analysis of flue gases by volume into per cent by weight.

TABLE NO. 6.

DENSITY OF GASES AT ATMOSPHERIC PRESSURE.

Gas	Symbol	Specific Gravity Air = 1	Weight of one Cubic Foot at 32° F. Pounds	Cubic Feet per pound at 32° F.	Relative Density Hydrogen = 1: Exact Relative Densities	Relative Density Hydrogen = 1: Approximately
Oxygen	O	1.10521	0.088843	11.257	15.96	16
Nitrogen	N	0.9701	0.078314	12.764	14.01	14
Hydrogen	H	0.069234	0.005589	178.930	1.00	1
Carbon dioxide	CO_2	1.51968	0.122681	8.158	21.95	22
Carbon monoxide	CO	0.96709	0.078071	12.818	13.97	14
Methane	CH_4	0.55297	0.044640	22.412	7.99	8
Acetylene	C_2H_2	0.898.20	0.073010	13.697	12.97	13
Aceylene	C^2H_2	0.89820	0.073010	13.697	12.97	13
Sulphur dioxide	SO_2	2.21295	0.178646	5.598	31.96	32
Air	...	1.0000	0.080728	12.383	.....	..

Adapted from Kent

TABLE NO. 7.

Gas	Analysis by Volume	Molecular Weight	Volume x Molecular Weight	Analysis by Weight
Carbon dioxide	12.6 %	12 + (2 x16)	554.5	$\frac{554.5}{3016.9} = 18.4\%$
Carbon monoxide	0.00%	12 + 16	0.0	$\frac{00}{3016.9} = 0.0\%$
Oxyegn	4.4 %	32	134.4	$\frac{134.4}{3016.9} = 4.4\%$
Nitrogen	83.2%	28	2328.0	$\frac{2328.0}{3016.9} = 77.2\%$
		Total....	3016.9	100.0%

JACKETING STEAM CYLINDERS.[1]

R. F. Chevalier: At the last meeting we had a discussion on high and low receiver pressure, and steam jacketing, but we were unable to come to any conclusions.

A. W. McDonald: As regards the subject of high and low receiver pressure let us determine which is the best.

H. D. Saville: For this purpose let us assume that the majority do not know anything about this subject and proceeding upon this assumption we will ask Lawrence to tell us what he knows about it. He will tell us about steam-jacketing and what its purpose is.

J. M. Lawrence: The object of steam-jacketing is to keep the steam in the cylinder, all that can be kept there, so that it does not lose its heat to the atmosphere.

John Traynor: Jacketing superheats the steam and gives better economic results. It is said that vacuum gets better results. I have not tried it; though I am convinced that the vacuum would be the proper thing. The engine might not show quite the energy that it would with superheating the steam in the jacket, but would give very much better results when one takes into account the efficiency of the plant as a whole because of less fuel being used. I contend and can prove that the steam-jacket on a cylinder as ordinarily used is absolutely worthless. The idea is that it increases the efficiency of the plant as a whole, with certain exceptions. Our object nine times out of ten is to produce and give power with less fuel. When a jacket is put on you do not do this.

R. F. Chevalier: The object of steam-jacketing is this: Supposing that steam enters the cylinder at a pressure of 20 lb. absolute which would be 5 lb. by gauge, and that the terminal pressure is 2 lb., equivalent to a vacuum of 26 inches. The temperature of the steam entering is 228 degrees F. When expanded to 2 lb. the temperature is 126 degrees F., causing a drop of 102 degrees. This has a tendency to cool the cylinder, and when steam is again admitted, some of the heat units are used to again raise the temperature of the cylinder, thus absorbing some of the energy that would have otherwise done useful work. Steam-jacketing is supposed to offset this loss.

H. D. Saville: As regards the number of foot-pounds of duty per thousand pounds of steam. In a pumping plant for example, the final result is not so much foot pounds of duty per given amount of steam, but rather the actual duty of putting a certain amount of water into the reservoir. Steam-jacketing is like this: if the combined heat units used in the cylinder in doing the work, and in the jacket, are measured, and the cost of producing this heat is known, that will represent the efficiency of the plant as a whole and this is the point in which we are interested. We are interested in the units generated in kilowatt hours but the thing in which we are particularly interested is the putting of the kilowatts on the board. In stating the question of steam-jacketing or economy of the plant as a whole everything is taken into consideration, inclusive of the benefit derived from the steam-jacket alone, and if there is not a saving it may not be worth the while. The best way to determine the value of steam-jacketing is to make tests with and without the jacket, all other conditions being kept the same.

C. E. Van Meter: I put up a compound condensing engine guaranteed to produce a horsepower on 13 pounds of steam. I jacketed both the high and low pressure cylinders, everything being jacketed to make it as efficient as possible. After it had run smoothly for some time one of the jackets sprung a leak and both jackets had to be cut out. In installing this plant everything was up-to-date; meters on the feed and oil pipes; reports filled out each shift by the engineers; the oil used, and the gravity, the number of gallons of water fed the boilers and the load on the engines being regularly read. When the

[1]Discussion at meeting of California No. 3, N. A. S. E., July 13, 1910.

jackets were cut out on account of the leak there were reports every twenty-four hours to show the difference in the consumption of fuel and oil. Cards were taken from the engines before and after the jackets were taken out. It was thus found that the consumption of fuel was just the same with jackets on or off, but the efficiency of the engine and the horsepower delivered per pound of steam were different and so I came to the conclusion that it was merely a scheme to boom the engines but that it does not affect the owner's pocket-book a bit.

W. H. Munro: My plant had 40 feet between cylinders and the jackets were a great help. The load was changed all the time. You could hold your hand on the low pressure cylinder. If you cut the jackets out the fireman knew the difference right away. However, this is an unusual case.

G. E. Van Meter: My engine is a high pressure one only. The steam enters the jacket at about 4 degrees F. above what the temperature due to the pressure would be but the steam was re-heated. The steam-jacket here would be a waste because of the re-heating.

R. F. Chevalier: Steam-jacketing supposedly overcomes condensation; therefore a loss of heat in the cylinders; thereby obtaining more work with a given quantity of steam entering the cylinder.

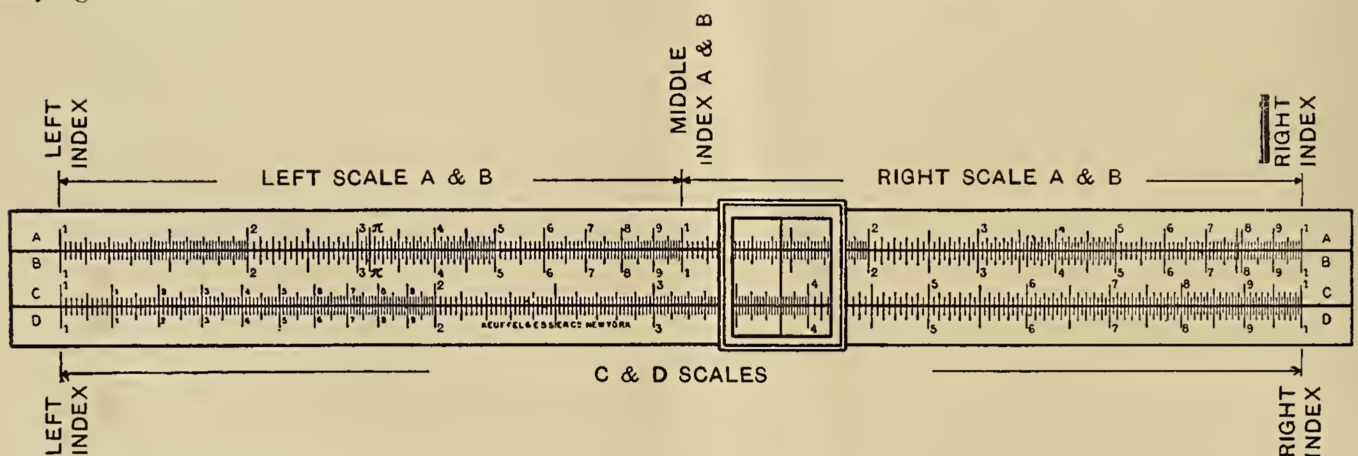
L. W. Holbrook: If you have a big compound engine for fire service and want to start up in a second, high and low pressure steam-jackets will make this possible, but there is no economy. This is a special advantage. Heat is on the steam-jacket all the time, and it takes but little fuel to keep the steam on all the time. At the present time it is an open question whether or not steam-jacketing pays when judged from the standpoint of fuel consumption. For emergency service as in the case of a fire pump the hot jackets make it possible to start up much more quickly than could be done with a cold engine.

THE SLIDE RULE.

BY J. G. DE REMER.

[The subject matter of the first lecture on the slide rule is contained in an article by Mr. De Remer in the issue of the Journal of Electricity for April 2, 1910.—Editor.]

The Mannheim slide rule has four scales; two on the rule, and two on the slide. These are designate as A, B, C and D scales as shown in the accompanying illustration.



The A and B scales are laid out to just half the length of the C and D scales. Hence the runner, if set opposite a certain number on the D scale is on the square of that number on the A scale. Thus over 2 on the D scale will be found 4 on the A scale; over 3 on D, 9 on A, etc.

For any given position of the slide the ratio of numbers opposite each other on the adjacent scales is constant. Thus set 2 on B over 3 on D and it will be seen that the ratio 2/3 exists throughout the range of the scales. This fact can be utilized in solving all problems in proportion by observing the following instruction:

C	Set first term	Under third term
D	Over second term	Find fourth term

Thus $2/3 = \frac{6}{?}$; by setting as above it will be found that 6 is over 9. This is a useful property of the slide rule, and by means of the following ratios the steam engineer can greatly facilitate his calculation:

226: 710 =	Diameter of circle : Circumference of circle.
79: 90 =	Diameter of circle : Side of equal square.
1: 231 =	U. S. gallons : Cubic inches.
800: 107 =	U. S. gallons : Cubic feet.
26: 66 =	Inches : Centimeters.
31: 200 =	Square inches : Square centimeters.
5: 82 =	Cubic inches : Cubic centimeters.
75: 34 =	Pounds : Kilogrammes.
57: 28 =	Inches of mercury : Pounds per square inch.
720: 26 =	Inches of water : Pounds per square inch.
60: 26 =	Feet of water : Pounds per square inch.
15: 17 =	Inches of mercury : Feet of water.
90:2960 =	Atmospheres : Inches of mercury.
34: 124 =	Atmospheres : Pounds per square inch.
125: 124 =	Initial pres. steam : Average pres. ⅞ cut off
55: 53 =	" " " : " " ¾ " "
37: 34 =	" " " : " " ⅝ " "
13: 11 =	" " " : " " ½ " "
31: 23 =	" " " : " " ⅜ " "
57: 34 =	" " " : " " ¼ " "

All problems in multiplication can be reduced to proportions similar to the above. Thus $2 \times 3 = 6$ may be read $\frac{2 \times 3}{1} = 6$ or $\frac{2}{1} = \frac{6}{3}$. Hence set 1 on C over 2 on D and under 3 on C find 6 on D or vice versa set 2 on C over 1 on D and over 3 on D find 6 on C.

The rule for multiplication is:

C	Set 1	Under the other factor
D	On one factor	Find their product

[1]Lecture given before California No. 3, National Association of Stationary Engineers, Aug. 4, 1910.

In division the procedure is similar $6 \div 3 = 2$ or $\frac{6}{3} = \frac{2}{1}$. Hence set

C	Set 3	Under 1
D	Over 6	Find 2

The rule for division is:

C	Set Divisor	Under 1
D	On Dividend	Find the Quotient.

In performing a successive multiplication or division the runner is useful. Thus:

Example: $12 \times 4 \times 5 \times 3 = 720$ is worked thus:

C	Set 1	Runner to 4	1 to Runner	Runner to 5	1 to Runner	Under 3
D	On 12					Find 720—Answer.

In the same way several divisions can be easily performed, and also a combination of multiplications and divisions, as in the case of a train of wheels, as

$\frac{71 \times 21.4 \times 35 \times 17}{8.5 \times 42 \times 5.8 \times 20} = 21.8$, which is worked thus:

C	Set 85	Runner to 214	42 to R	R to 35	58 to R	R to 1	20 to R	Under 17
D	On 71							21.8—Answer.

A little practice will enable similar problems to be worked out with ease. No notice has so far been taken of the real position of the decimal points, the finding of which has been left to inspection, which in many problems is all that is necessary. We now give the rules in full with examples and explanations.

Multiplication.—If the product is obtained with the Slide projecting to the left, its characteristic is the sum of the characteristics of the two factors; but if the Slide projects to the right, the characteristic of the product is the sum of the characteristics of the two factors less 1.

Example: $45 \times 2.5 = 112.5$.

The sum of the characteristics of the two factors is 3, and the Slide projects to the left, therefore the integral portion of the product is composed of three figures.

Example: $3.3 \times 18 = 59.4$.

The sum of the characteristics of the two factors is 3, but to obtain the result, the Slide projects to the right. The product contains, therefore, $3 - 1$, or two figures only in the interger.

Division.—If the quotient is obtained with the Slide projecting to the left, its characteristic is the characteristic of the dividend, minus the characteristic of the devisor; but if the Slide projects to the right, this difference must be increased by 1.

Example: $33 \div 7.5 = 4.4$.

The characteristic of the dividend, less the characteristic of the divisor, is 1, and as the Slide projects to the left, the integral part of the quotient contains one figure.

Example: $65.1 \div 21 = 3.1$.

The characteristic of the dividend, less the characteristic of the division, is 0, but as the Slide projects to the right, the quotient contains $0 + 1$, or one digit in its integral portion.

The slide rule is of value to an engineer only in proportion to the amount he endeavors to use it. It becomes a habit, as it were; and once mastered the rule seems indispensable.

To master it requires only a little application to the elementary problems after which the more complex becomes clear.

The engineer is referred to the "Mannheim Manual on the Slide Rule" for further explanation of its use, it being from that text that most of the above data was obtained.

PROTECTIVE DEVICES FOR ELECTRICAL APPARATUS.[1]

BY A. G. F. HEATHER.

The question of the adequate protection of electrical apparatus is one that deserves careful consideration by those concerned in the running and maintenance of plant. In the early days, when power undertakings were limited in area, and supply was carried out almost entirely by continuous currents at low voltage, the problem presented few practical difficulties. Fuses, which at first met any case that was likely to arise, were gradually superseded more or less by automatic circuit breakers, which were soon brought to a state of great reliability, and rendered excellent service under severe conditions. The advent of alternating current transmission at high voltage over great distances, and the development of power undertakings have, however, considerably changed the nature of the problem. At the present time, one of the essential features of protective devices, especially in the case of a large supply company, is that they must be so adjusted as to protect promptly and certainly the particular section of the system to which they are applied, without interfering with the supply to any other portion of the system. Each consumer's substation must be protected, so that a fault on the installation or low tension net work will cut out the installation only, without tripping the distributor which supplies probably several other consumers, and similarly, a fault on a distributor must trip only that line at the control house from which it is fed, without interfering with the feeder which supplies the control house from the generating station. Then, again, it must be remembered that temporary overloads, earths, and surges are very common occurrences, and must be carried without any interruption to supply. Any temporary disturbance, such as induction caused by a lightning discharge, an earth, or the opening of a switch carrying load, may cause surges all over the system, which would be quite heavy enough to trip other switches. With proper protection against excessive voltage, such as static discharges, these surges would be cleared in a few seconds, and hence the necessity has arisen for introducing time elements in trip gear, so arranged that a switch will only trip after an overload has been on the circuit for some appreciable time.

[1]Abstracted from May 1, 1910, Transactions South African Institute of Electrical Engineers.

The time elements may be fixed, so that the switch will trip after a definite number of seconds have elapsed, irrespective of the severity of the overload, or they may be inversely proportional to the overload.

As the question of alternating current supply is of very much wider interest to us on the Witwatersrand at present, I do not propose in these few notes to refer at any length to the protection of continuous current systems. Continuous current circuit breakers find by far their largest field in traction work and are, therefore, of most interest to traction engineers. They are practically all built on one principle, this being rendered possible by the fact that they are all operated on low voltage systems, although, of course, there is great variation in details of design as there must necessarily be in all switch work.

Turning now to the protection of alternating current systems, we find that the problem with which we have to deal is different, mainly because of the fact that nearly all alternating distribution is carried out at voltages which prohibit, or at least render undesirable, the direct connection of tripping devices to the main supply. This, however, is not altogether a disadvantage, as it introduces the possibility of actuating all tripping gear with a current of about 5 amps. at a pressure of 100 volts, by the use of current and potential transformers, thereby considerably cheapening and simplifying the wiring of the switch-board.

Apart from the protection of electric plants from lightning, with which it is impossible to deal in so short a paper as this, the main points to be considered are the prevention of injury from overloads, failure of supply, and reverse currents.

Overload protection is generally necessary in the case of feeders and motors, and may be accomplished in the same way on alternating as on continuous current systems. The growth of supply undertakings, and the consequent necessity of localizing interruptions as far as possible, and of carrying temporary overloads without any interruption at all, have, however, made it imperative to develop a system of protectection capable of close adjustment as regards comparative severity of overload and its duration. These ends may be attained either by the use of fuses or of relays.

Fuses on the whole do not present a satisfactory solution of the problem of protection against overload. The design of fuses has made enormous strides since the early days of power transmission, when a fuse was simply a bit of wire clamped at each end under a thumb screw. A fuse for a 500 volt circuit was then looked upon as rather an uncertain piece of apparatus. It could be relied upon to break the circuit, centainly, but it might also break a good many other things in doing so. Fuses are now designed to operate on circuits of 60,000 volts, and they afford satisfactory protection without causing any serious after-effects. Nevertheless, they are open to many objections which render them less reliable than other systems of protection which depend for their action on purely mechanical and magnetic principles. Small local flaws, variations in cross section and chemical composition, cooling facilities, aging of the wire, security of contacts, and the temperature of the fuse previous to the occurrence of an overload all influence the blowing point to a certain extent, and contribute towards making the fuse on the whole unreliable. An old fuse rated at 100 amps may blow sooner than a new one rated at 50 amps on the same circuit. Fuses can only be calibrated by destruction, and the blowing point of one fuse is in many cases no indication that another of the same type will blow under the same conditions.

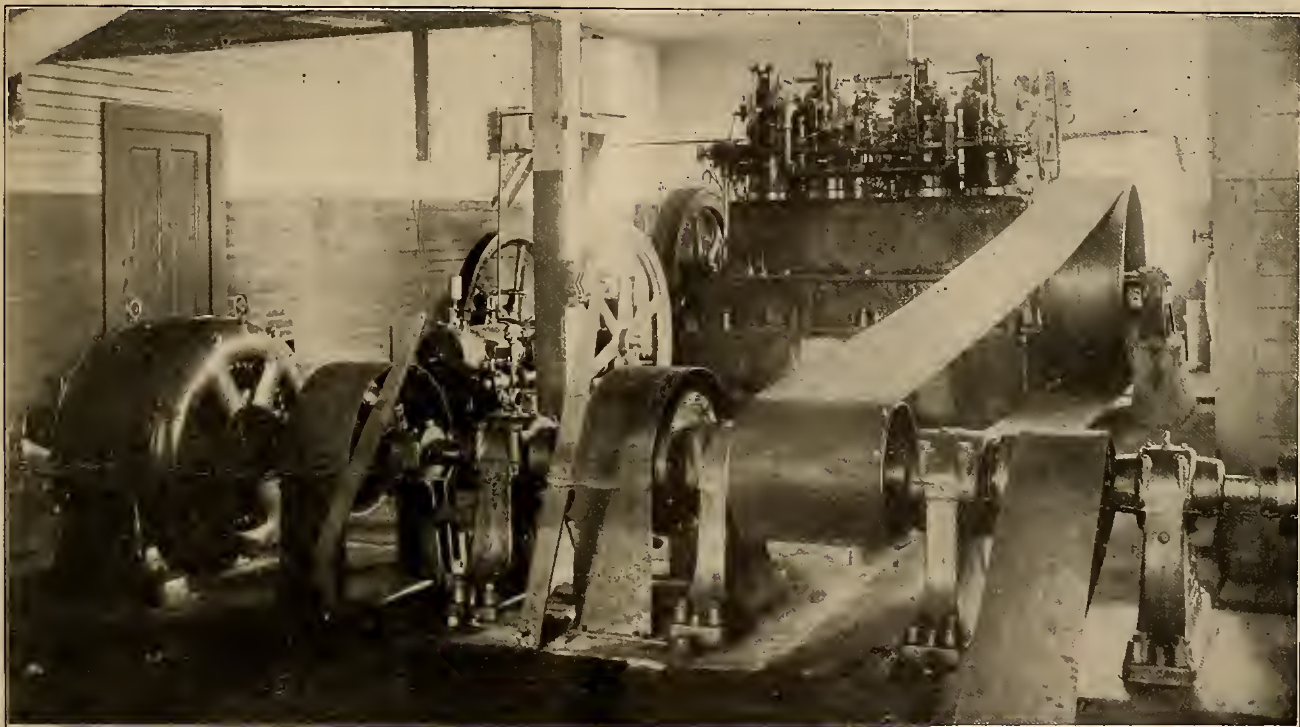
Methods of protection depending on purely magnetic and mechanical principles possess advantages over fuses, inasmuch as both the overload and time elements can be adjusted with great accuracy, and can be periodically checked and altered as the requirements vary. The actual tripping of the switch is accomplished in the same way with alternating as with continuous currents, namely, by causing a plunger controlled by a solenoid to strike the trigger by which the switch is held in position. The overload and time limits depend upon the action of a relay, or in some cases upon the blowing of a fuse connected in parallel with the tripping coil. In the latter case, the tripping coil is not intended to carry the full load current of the current transformer which operates it, but being of higher resistance it is short circuited by the fuse. This type of tripping gear is very useful in cases where no auxiliary current is available, and close adjustment is not of great importance, but it is open to the objections already mentioned in respect of the fuses.

A far preferable arrangement where an auxiliary tripping circuit, either alternating or continuous current, is available, is to employ relays. The use of an auxiliary current has the great advantage that the force employed to operate the main switch is invariable, whatever the load on the relay may be. In three-phase work it is advisable to use two or three single-phase relays, rather than to combine the action in a three-phase relay.

Coming now to the question of protecting generators operating in parallel, it is usual to dispense entirely with overload relays, and to rely solely on reverse current protection, or in some cases to have no protection whatever, but merely an indicating device for each machine, which will warn the switchboard attendant in case a fault develops on any machine. A modern generator will carry a heavy overload for a time sufficient to enable the attendant to take steps to remove any fault on the system, or in case of necessity to run up and synchronize another machine. Overload protection on generators is rather a source of danger than otherwise, since, if a heavy overload comes on, or a fault develops, causing one machine to trip, the load will all be thrown on the other machines, and they will probably trip as well, causing a total shut down of the plant. The best system to adopt is generally accepted to be only reverse-current protection for generators, and overload protection for feeders, together with some discriminating device in the case of duplicate feeders and ring mains. These discriminating devices, some of which will be dealt with later, are so arranged as to cut out only the faulty section of the feeder or feeders, while an uninterrupted supply can be maintained on the sound sections. With only reverse current protection on the generators, the bus bars are left unprotected, but faults on bus bars are, or should be, comparatively so rare that this is not really a serious objection. Reverse-current protection will cut out a

generator for any fault in itself or its prime mover or exciter, but will leave it free to carry any ordinary overload that it may be called upon to take, provided its power factor does not fall too low.

Reverse-current relays are, in general, similar to overload relays, except that they depend for their action on the resultant or a shunt and series field. On inductive circuits it is usual to arrange the coils so that they act in direct opposition at the normal power factor. If the current becomes reversed in phase the action of the series coil is added to that of the shunt coil, and the relay at once operates. In practice, however, the relay is generally set to operate at low power factor, that is, before an actual reversal of the phase of the current takes place. A certain margin of reverse current is usually allowed in order to avoid tripping a machine if it should happen to be paralleled when slightly out of phase.



Power Plant of Winnemucca Light and Water Co.

In addition to protecting motors against overload, it is necessary to arrange for the motor to be cut out in case of failure of supply, owing to the absence of any external resistance in the armature or rotor circuit when the motor is running at speed. This point is of very much greater importance when the power is supplied from an outside source than in the case of a private supply, as in the former case it is essential that the supply should be resumed as quickly as possible, without reference to the time required by any individual customer to go round and switch out all his motors by hand.

The system adopted for cutting out motors in case of failure of supply, is to connect a solenoid across the mains. The solenoid is energized as long as there is voltage on the system, and consequently holds its armature in position. Immediately the voltage fails, the armature is released. In some cases this shunt coil is applied to the main circuit breaker, and operates the same trigger as the overload coil. Occasionally, however, more especially in the case of small motors, the shunt coil is fixed on the motor starter and operates on the switch arm against the action of a spring. When all resistance is cut out the switch arm is in contact with the pole-pieces of the shunt coil, and forms the armature for them.

On high tension systems no voltage release can be accomplished in the ordinary manner by means of potential transformers and relays, the latter of course being set to operate instantaneously.

THREE IN ONE.

It is seldom that an electric power plant is equipped with three prime movers, a water-wheel, a gas engine and a steam engine, as shown in the accompanying view of the Winnemucca Light & Water Company's plant at Winnemucca, Nevada. The water-wheel is a 150 h.p. Pelton, the gas engine a 175 h.p. Doak all belted to the same driving shaft as is the 125 h. p. steam engine. Any one, two or three of these engines at will can be used to operate the two 50 kw. generators supplying light and power to Winnemucca.

The chief reliance for the greater part of the year is placed upon the water wheel which is supplied from a 500,000 gallon reservoir four miles from the plant through a pipe line made up of 12, 10 and 8-in. pipe, there being 7500 ft. of each. The head is nominally 1100 ft. varying with the change of season from wet to dry. The water as discharged from the wheel is collected in settling reservoirs of cement where it is piped throughout the town for general use.

The gas and steam engines are stand-by auxiliaries for use during periods of low water or at times of overload, a not infrequent occurrence. This novel combination was installed by Mr. W. L. Aiken, the superintendent of the plant.

JOBBERS' MEETING AT DEL MONTE.

A convention of the Pacific Coast Electrical Jobbers' Association was held at Del Monte, California, August 4, 5 and 6, 1910. Invitations had been extended to a number of manufacturers' agents, their presence contributing to the success of the meeting. Thursday was devoted principally to golf practice and other amusements. The business meeting was called to order at 9:30 a. m. Friday and lasted through the entire day with an evening session till 9:30 p. m. Saturday morning the meeting was called to order for final work and adjourned at 9:30 a. m. to meet again at Catalina Island for the fall meeting. Golf formed the principal pastime, the incentive being a handsome silver cup presented by Mr. Clark, son of Senator Clark of Montana, whose interest as a copper producer is closely allied with the electrical jobbers as copper consumers. The excellent singing of Frank Fowden was the primary cause of the presentation, which was handily won by W. L. Goodwin of the Pacific States Electric Company with a gross low score of 87. The score of 88 made by W. S. Berry of the Western Electric Company, made a close second.

The banquet was held on Saturday evening, the management of the Del Monte Hotel excelling themselves not only in the decoration but also in the viands. Tracy Bibbins of the General Electric Company acted in his usual graceful way as toastmaster and the feast of reason and the flow of soul that emanated from that festive board were gems of thought that the Journal regrets exceedingly cannot be given in full.

After R. S. Holabird had entertained his listeners in lighter vein, E. K. Patton gave an able address on "Co-operation Between the Jobber, Manufacturers' Agent and Manufacturer," speaking in the highest praise of the harmony and strength shown by the local representatives of these interests. His remarks formed the basis of much that followed and were received with hearty applause.

The toastmaster in behalf of the association then thanked Mr. Clark for his generous gift and suggested that he be made an ex-officio member. The motion was carried unanimously and three hearty cheers were givn for the donor. Mr. Clark addressed the meeting and in well chosen words expressed his pleasure at being a member, and advised everyone present to devote their spare moments to practicing golf, for it was his intention to present a cup for the National Convention of the Electrical Jobbers which is to to be held at Del Monte in April. Will Goodwin of the Pacific States Electric Company was then requested to give his excuses as to how he happened to win the trophy. If there is one thing that Mr. Goodwin is justly entitled to, it is the sobriquet of "Honest Bill." He told of his great disappointment in his first drive, which he had hoped and prayed would be a perfect one, when the ball landed in the thick underbrush some distance from the links. After finding the ball he was about to make a massé shot, when he noticed a few feet from the ball a large snake coiled ready for a spring. He admitted that he was superstitious and that in order to win the trophy he must first kill the snake. Decision and action was the work of a moment. With a dry blade of grass he smote the snake and its dead carcass lay there in evidence. While there was no need of corroboration. Mr. R. S. Holabird stated that he had seen the snake if anyone doubted the story. The next drive was a trophy winner as it proved at the conclusion of the game.

Colonel Carter, also of the Pacific States Electric Company, was next called upon to address the meeting from the standpoint of the jobber. He handled his subject not only with skill but with convincing arguments. When he had finished the applause of approval was equal to the reception to Mr. Patton's address.

A. Z. Thompson of the General Electric Company, when asked to entertain the company, in most poetic language weaved a story so weird that for the nonce all felt that the beauty had pierced the ivory dome of even the most obtuse. F. F. Skeel of the Crouse

Members and Guests at Del Monte Meeting, Pacific Coast Electrical Jobbers' Association.

Hinds Company of Boston, ably seconded Mr. Patton's argument from the manufacturer's side of the question. Charlie Carter of Los Angeles told how he happened to be entitled to have his name engraved on the jobbers' cup. As co-operation was the slogan of every speech he explained how how he had won through co-operation. A cigarette given to one of the handicappers the evening before, gave him an enormous handicap. The constant coaching of John Cole throughout the game cinched the co-operation.

Then the patriarch of the manufacturers' agents of the Pacific Coast, John R. Cole, in his frank and straight from the shoulder manner, carried his audience by storm and asked that the jobbers be jobbers only, that the manufacturers confine themselves to manufacturing and thus allow the manufacturers' agents to co-operate to the last ditch.

providing a cup for which the jobbers are to compete. This is to be known as the Patton cup.

After the banquet, dancing and music was the order of the hour. Mr. Thompson and Mr. Holabird favored the audience with instrumental and vocal music, as did several of the guests of the hotel, among whom was Miss Lillian Berry.

The members and guests present were: H. V. Carter, C. H. Carter, W. S. Berry and wife, Frank Fowden, J. Shaufelberger, H. V. Averill, S. R. Dederick, T. E. Bibbins, C. C. Hillis, N. W. Graham, R. D. Holabird, J. S. Eels, F. B. Gleason, W. L. Goodwin and wife, Albert H. Elliott, Henry Frosch, H. G. Aylsworth, John R. Cole, Garnet Young, H. B. Squires, H. E. Sanderson and wife, S. B. Gregory, E. K. Patton, F. F. Skeel, E. J. Dwyer, Duncan Reynolds, A. Z. Thompson, E. B. Strong and wife.

The Cup Winners and Others.

Mr. Albert Elliott, beloved secretary of the association, in a flow of oratory and good stories, closed one of the most successful meetings the jobbers have ever held. The loving cup went the round. Old Lang Syne was sung and the co-operative meeting of manufacturer, manufacturers' agent and jobber passed into history.

As the competition for the cup put up by the jobbers for their guests had proven a tie between Mr. Patton and Mr. Gregory, the banquet was interrupted long enough to allow the tie played off in an individual putting contest on the carpet. A dainty flower was placed at each corner of the room indicating the hole, and the two contestants gave an exhibition of their skill. The first two holes were won by Mr. Gregory, the third by Mr. Patton and from the position of Mr. Gregory's ball after the fourth shot, it was suspected that Mr. Patton preferred to leave the cup on the coast than to take it East with him, for in place of a put Mr. Patton gave more of an exhibition of a drive from the tee, and Mr. Gregory was declared the winner. Mr. Patton of Bryant Electric Co. then announced his intention of

SCORE CARD.

Name of Player.	Gross Score.	Handicap.	Net Score.
W. L. Goodwin	87	0	87*
W. Berry	88	0	88
R. D. Holabird	94	†1	95
H. E. Sanderson	96	†10	106
C. C. Hillis	100	2	98
H. V. Carter	102	1	101
D. L. Reynolds	103	0	103
C. H. Carter	104	27	77‡
T. E. Bibbins	107	3	104
F. B. Gleason	112	3	109
J. S. Ells	112	22	90
S. B. Gregory	114	27	87†
E. K. Pallon	114	27	87
A. H. Elliott	117	18	99
H. B. Squires	125	27	98
J. R. Cole	126	10	116
C. R. Dederick	127	27	100
N. W. Graham	129	27	102
Jno. Schaufelberger	172	27	145

* Winner of best gross score, Clark's trophy.
‡ Winner of best net score cup.
† Winner of Manufacturers' cup.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.
DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Lubrication

Notwithstanding the large sums annually spent for lubricating oils, friction continues to create a tremendous power waste. Some authorities estimate that more than half of our fuel is consumed by friction, a large proportion of this waste being due to imperfect lubrication. Friction is a form of mechanical resistance and as such not only opposes the motion of rubbing surfaces but also causes them to wear and become overheated, the last being a too-frequent fire hazard.

Experience has shown that friction may be minimized by proper choice of bearing metals and by the intervention of some unctuous substance. Contact of dissimilar metals, such as a steel journal and a babbitt bearing, gives the best results for most requirements. It is necessary to exercise constant care to keep these rubbing parts in good condition, it being an absolute necessity that they be smoothly milled to true surfaces in order to reduce friction to the lowest increment of the power in use.

Lubrication's prime problem, however, is the proper introduction of an oil or grease that will keep the moving materials apart by means of a continuous, coherent and durable film having small internal friction. The first lubricant was water, which, while possessing no oiliness, is still used in cylinders to keep metallic surfaces smooth. Various oils and greases of animal or vegetable origin were next employed, but were soon superseded by mineral oils or by mixtures of both, these compounded oils being valuable in heavy work which breaks down lighter oils. Later it was found that excellent heavy lubricators could be prepared from the crude petroleum of Texas and California if carefully refined so as not to decompose the original constituents. Recently it has been found that deflocculated graphite, originally prepared in the electric furnace by Acheson, is an efficient lubricating agent for many forms of mechanical work. A small proportion of graphite mixed either with oil or water, the latter being merely a distributing vehicle, quickly forms a veneer that smooths the bearing surfaces and reduces to a minimum the coefficient of friction, that ratio of the force necessary to slide a body along a horizontal plane to its weight.

No one of the above lubricants is universally applicable, each particular kind of machine and special service to which it may be applied constituting a different problem. The chemical engineer has devised a series of tests by which it is possible to select the oil best adapted for the required work. In making such tests it should be his constant endeavor to closely approximate service conditions of speed and load, kind of bearings and method of feeding. It is thus possible to guard against the likelihood of a compressor oil carbonizing at the high temperature inherent in compressing air, or of an oil used in a circulating system, such as a steam turbine installation, emulsifying or oxidizing so as to clog or corrode the bearing. The full measure of power plant economy may be attained only by vigilant attention to such precautions.

PERSONALS.

E. K. Patton of the Bryant Electric Company is at Portland.

S. K. Colby, head of the railway department of Pierson, Roeding & Co., is at Los Angeles.

G. W. Merrill, superintendent of the Sacramento Electric, Gas & Railway System, has tendered his resignation.

Sidney Sprout is at Winnemucca, Nev., on engineering business for the Winnemucca Light & Power Company.

R. D. Holabird of the Holabird-Reynolds Company, has returned to San Francisco after an extensive Eastern tour.

Duncan L. Reynolds, of the Holabird-Reynolds Company's Los Angeles branch, spent the past week at San Francisco.

Edward G. Dewald, who recently joined the sales force of the Pelton Water Wheel Company, has returned from Utah.

Charles Casassa has been promoted from chief clerk to assistant auditor of the Pacific Telephone & Telegraph Company.

C. E. Ingalls was recently appointed manager of the small motor department of the Los Angeles office of the General Electric Company.

E. J. Dwyer, manager of the Holabird Electric Company, of Seattle, has returned to Puget Sound after spending a few days at San Francisco.

W. Jamieson, first assistant engineer of the Merchants' Exchange Building plant in San Francisco, is again on duty after his summer vacation.

Leon M. Hall, consulting engineer for the Comstock mines, has returned to his San Francisco office after an automobile trip to Virginia City, Nev.

D. P. Fullerton, division superintendent of the lines of the Pacific Telephone & Telegraph Company, has been making an inspection tour in Southern California.

W. S. Cone, superintendent of construction on the Great Western Power Company's large dam at Big Bend, spent a day at the company's city office during the past week.

Thomas Mirk, of Hunt, Mirk & Co., who recently returned from Eureka, is about to visit the Westinghouse Machine Company's works at Pittsburg. His itinerary will also include New York, Chicago and Milwaukee.

F. C. Phelps, C. W. Burkett and G. B. Bush, respectively auditor, general superintendent of plant and general commercial superintendent for the Pacific Telephone & Telegraph Company are making a trip over the Northwestern Division.

George F. Averill, president of the Coos Bay Traction Company is at San Francisco to confer with some of the backers of the new railway enterprise which will connect Marshfield, Ore., with a number of the towns in the Coos Bay region.

Dwight B. Dean, manager of the Kuhlman Car Company, Cleveland, Ohio, (one of the Associated Brill Companies), is at Los Angeles on a tour of the Pacific Coast. He will later visit Pierson, Roeding & Co., who represent his company at San Francisco.

J. E. Jones has joined the John G. Sutton Company as a construction foreman. He will be employed on the $11,000 wiring contract that the company has secured for the elaborate decorative street lighting for the Native Sons' Admission Day Carnival in September.

G. R. Field, assistant general manager of the Great Western Power Company, returned last week from an inspection tour covering the new work under way. Rapid construction work is reported on the dam at the Big Bend plant, while the exploration work for the projected impounding dam at Big Meadows is progressing nicely.

ELECTRIC SHOW EXHIBITORS.

Following is a partial list of exhibitors at the Pacific Coast Electrical Exhibition to be held in San Francisco September 17—24, 1910:

Standard Underground & Cable Co., American Steel & Wire Co., John R. Cole Co., H. W. Johns-Manville Co., National India Rubber Co., Elec. Ry. & Mfrs. Sup. Co., Kellogg Sw. Bd. & Sup. Co., Dean Electric Co., Crocker-Wheeler Co., Engineering & Maintenance Co., National Dictograph, General Acoustic Co., Benjamin Elec. Co., Holophane Elec. Co., H. F. Frosch Co., Collins Wireless Tel. Co., Parrot & Co., Aylesworth Agencies, Babcock Electric Vehicle Co., Rauch & Lang, Columbus Vehicle Co., Electric Review & Western Electrician, Pacific Electric & Mfg. Co., Home Tel. Co., Weston Elec. Instrument Co., Levy Electric Co., Otis & Squires, Electric Cleaner Co., Electrical World, S. F. Compressed Air Cleaning Co., Holabird-Reynolds Co., Drendell Sw. Bd. & Sup. Co., Keller Mfg. Co., Telephone Elec. & Equip. Co., Elec. Mfg. Co., National Elec. Lamp Ass'n., Amer. Ever Ready Co., Walters Surgical Co., Studebaker Bros., Elec. Storage Battery Co., Direct Line Tel. Co., Burroughs Adding Mch. Co., Southern Pacific Ry., Grant Flaming Arc, Sprague Elec. Co., General Elec. Co., Ft. Wayne Elec. Co., Laugenour Sales Co., Appleton Elec. Co., National Elec. Co., Excello Arc Lamp Co., Federal Sign Co., Pierson-Roeding & Co., Daggett & Co., Paraffine Paint Co., Kohler & Chase, C. C. Moore & Co., Cal. State Ass'n. of Elec. Contractors, Baker & Hamilton, Hoover Suction Sweeper, Stave Elec. Co., Simplex Elec. Co., University of California, Santa Clara College, Gray Telautograph Co., Cyphers Incubator Co., American Elec. Fuse Co., S. F. Gas & Elec. Co., Pacific States Elec. Co., Amer. Ironing Mch. Co., City Electric Co.

TRADE NOTE.

William D. Ward is at Denver, where he has closed up a large hydro-electric contract for the Pelton Water Wheel Company in connection with a development in Colorado.

R. F. Chevalier has removed his office and laboratory from Alameda to 729-731 Merchants' Exchange Building, San Francisco, Cal., where he is equipped to better the fuel economy of steam power plants.

The General Electric Company has sold to the San Joaquin Light & Power Company a 2000 kw. Curtis Steam turbine which is to be installed at Bakersfield where the Power Transit Company's plant was recently acquired. The new equipment comprises one A. T. B. 4, 2000 kw., 1800 r.p.m, 2300 v., horizontal condensing turbine generator set, arranged for 185 pounds steam pressure (with 2 pounds absolute back pressure) and one C. C. 8, 35 kw., 3600 r.p.m., 125 v., slant, 125 v., condensing Curtis turbine exciter set.

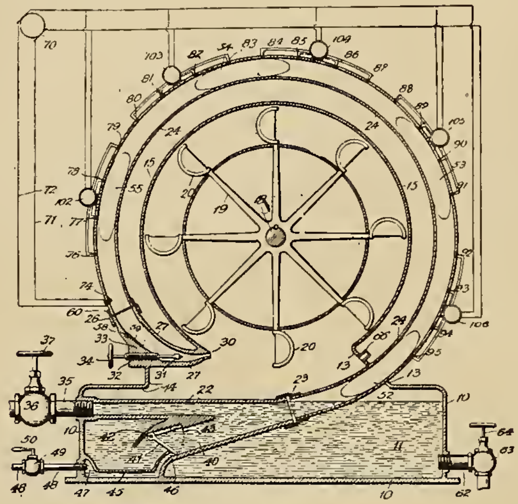
NEW CATALOGUES.

"The Cost of Light," by S. E. Doane, is ably treated in Bulletin 9A from the Engineering Department of the National Electric Lamp Association. The subject is first considered under the three heads of the cost of electrical service, the cost of electrical energy and the cost of lamp renewals, their weighted effect determining a logical central station rate.

The Electric Storage Battery Company has issued a booklet entitled "How to Get that Undeveloped Central Station Business." This book is for the purpose of interesting central stations in the popularization of the electric vehicle and explains how profitable this business is, and how easily it can be procured. Opinions of some central station experts are also given and diagrams showing methods of charging electric vehicles, both from d.c. and a.c. circuits. The booklet also contains announcements from eighteen electric vehicle manufacturers.

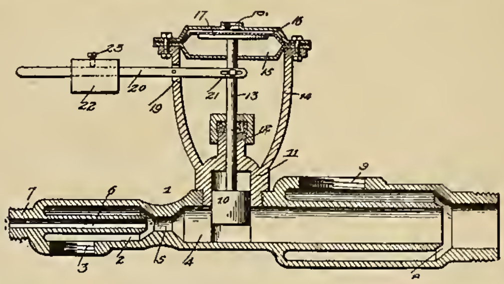
PATENTS

965,985.. Combined Liquid and Gas Turbine. Carl E. Brockhausen, Chicago, Ill. In mechanism of the class described the combination of an impulse wheel, mechanism by means of which the working fluid causes said wheel to rotate, means for admitting an explosive gas to said working fluid



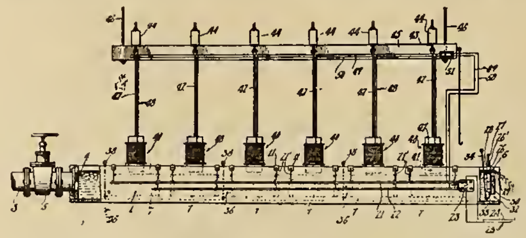
before it operates upon the wheel, means for exploding a bubble of gas upon the working fluid about to operate upon the wheel and mechanism for then successively exploding other bubbles of gas at different distances from the point where the working fluid operates upon the wheel.

966,373. Automatic Feed Regulating and Mixing Device for Crude-Oil Burners. Joseph B. Willings, Maricopa. Cal. A fuel feeding device for crude oil burners comprising a conducting tube having in one end an oil chamber, a steam injecting tube in said oil chamber, a mixing chamber surrounding the outer end of the conducting tube, a valve casing provided with a hollow dome screwing in the conducting tube between the mixing chamber and oil and steam injecting chambers, a regulating valve arranged in said conducting



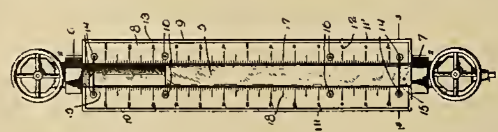
tube and movable into the valve casing to regulate the quantity of oil and steam passing through the tube, a weighted lever pivoted to the casing and having a slotted engagement with the valve stem to normally hold the valve in raised position, a disk upon the upper end of the valve stem, an elastic diaphragh arranged in the casing and engaging said disk, and a cover plate having a steam inlet opening over said diaphragm, the diaphragm being adapted to move the valve in a cut-off position when the pressure of steam thereupon overbalances the weighted lever.

966,025. Apparaus for Purification of Sewage and Other Waters.. Lewis G. Lautzenhiser and Charles P. Chandler, Los Angeles, Cal., assignors of one-half to De Witt A. Siemmer and Shirley C. Ward, and said Chandler, assignor of one-twentieth to W. K. Reese, Jr., Los Angeles, Cal. An apparaus for the deodorization of sewage, comprising a flume having a smooth, continuous, imperforate bottom, a plurality of sets of electrodes supported in said flume, said electrodes extending in planes parallel to the length of the flume, a cross board extending transversely of the other end of the flume and separated



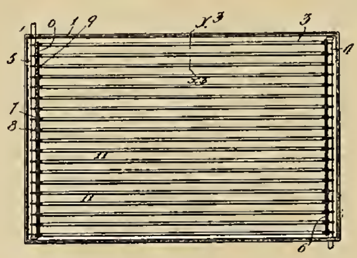
from the bottom of the flume to form a discharge outlet between said board and adjustable vertically to control the level of the sewage in the flume and the normal discharge from the flume, a discharge gate hinged to said cross board and extending downwardly therefrom to the bottom of the flume to normally close the said discharge outlet, and manual operating for opening said discharge gate.

966,323. Water-Gage Attachment. Zachariah C. Ferris, Caldor, Cal. A water gage glass attachment comprising an oblong sheet provided at distances from its opposite ends, equal to the width of the sheet. with rows of transverse indentations and having one of its flat surfaces coated with a light color, a pair of angular-shaped channeled strips flanking the opposite ends and portions of the opposite sides of said sheet and extending to points approximately in alinement with the adjacent rows of indentations, and a second pair of chan-



neled strips arranged on the opposite longitudinal sides of said sheet and having their inner ends bearing on the extremities of the first-named strips in alinement with the indentations and their outer ends bearing on the opposite or outer extremities of the first-named strips, the outer end portions of the second-named strips being bendable over opposite ends of the sheet after the portions of the laater in advance of the indentations together with the first-named strips have been removed.

966,070. Solar Heater. William J. Bailey, Monrovia, Cal. A solar heater comprising a series of tubes of extended length and of relatively small cross section in communication with each other, and sheets of copper connected with the



botom walls of the said tubes for conductive heat to the lower part of the tube in which the colder water is, said sheets being in heat absorbing relation to the sun's rays for imparting additional heat to the tubes.

INDUSTRIAL

NATIONAL ELECTRIC LIGHT ASSOCIATION PLANS FOR THE ELECTRIC SHOW.

The advance of the electrical industry during the past decade has truly been phenomenal. The development has been so rapid that for a long time only the technical man was able to keep himself well informed regarding the progress made. The recent development of the industry has been largely along lines that are particularly interesting to the general public.

Fortunately, it is human nature to be inquisitive about new things. It is, therefore, natural to assume that the public is desirous of becoming acquainted with recent inventions and particularly those which promise to add to the comfort or safety of man. Manufacturers of electrical apparatus and devices have very gladly seized the opportunity thus afforded to place their products before the public for inspection, and consequently enormous sums of money are annually spent for the purpose of exhibiting goods of every description at industrial expositions. These expositions have aided materially in educating the public, and as a result have become exceedingly popular in several of the larger cities of the East. The names "Chicago Electric Show" and "New York Electric Show" have become widely known.

Many manufacturers consider the preparation of exhibits for these expositions as a regular part of the year's work. During the past twelve months electric shows of no mean success have been held at Boston, Minneapolis and St. Louis. Each year, also, there is a commendable exhibition of electric apparatus held in connection with the convention of the National Electric Light Association. The object of this exhibit is to bring to the attention of the association members, who represent a very large portion of the leaders in the electrical industry today, the annual progress in the application of electricity.

The East, then, is the pioneer in the promotion of electrical expositions. That the West has recognized the importance of promoting the general application of electricity is evidenced by the elaborate plans which have been made for an electrical exposition to be held in San Francisco, beginning September 17th.

Many of the largest manufacturers of electrical apparatus are planning to have elaborate displays at this exposition. The handsome new Coliseum building is admirably adapted for shows of this sort, and will admit of a most attractive scheme of decorating.

Fig. 1. National Electric Lamp Association Exhibit at New York Electric Show, 1909.

Judging from electrical shows held in the East, one of the most attractive exhibits at the coming exposition will be that of the National Electric Lamp Association, the largest exclusive manufacturers of incandescent lamps in the world. The member companies of this association, through their engineering department in Cleveland, Ohio, have adopted a liberal policy governing their exhibits at electric shows.

Illustrations of what the National Electric Lamp Association has been doing in the past in the way of assisting these educative campaigns is shown in the accompanying pictures. Fig. 1 shows their elaborate booth at the New York Electric Show held at Madison Square Garden in October, 1909. This is one of the largest of the electrical expositions,

Fig. 2. National Electric Lamp Association at Atlantic City, 1909.

and attracts thousands of people annually. Fig. 2 shows the exhibit of this association at the thirty-second annual convention of the National Electric Light Association held at Atlantic City in June, 1909. The most recent exhibit of the company is shown in Fig. 3. This was the booth at the St. Louis Electric Show held in the Coliseum in June, 1910.

In view of the fact that the San Francisco show is to be the first large electrical show to be held on the Pacific Coast, the manufacturers are sparing no efforts to make it a success, and from present indications the show promises to equal anything of its kind ever held in the East or West.

NEW INTERPOLE RAILWAY MOTOR.

In further extending its line of railway motors Allis-Chalmers Company has recently placed on the market its Type 501. This is an interpole motor which has been developed to meet severe conditions of operation, especially on lines which use a potential of 600 volts or over. It also has desirable features for use where a lower voltage is employed.

As is seen by the accompanying photograph, the motor is unusually sturdy and strong with ample provision for wearing surface in the bearings. The arrangement of the interpoles can also be plainly seen. Special arrangements are made for ventilating the motor and therefore very cool running is secured.

The field frame is constructed of high quality cast steel and is split horizontally through armature and axle bearings so that it may be opened downward. The commutator and brushes can be readily inspected by means of an opening of large size which can be covered when the motor is not being inspected.

The main pole pieces are of soft steel punchings, securely clamped between malleable iron end plates, to which they are riveted. The interpole or commutating pole pieces are of solid steel. The field coils are of the mummified type thoroughly insulated and with the insulation impregnated with a moisture and water-proof compound. The coils are firm and have excellent heat conducting properties which assist in the cool running of the motor.

The bearings are bronze with a thin lining of babbitt and are carefully fitted to the bearing housings. Ample lubrication is provided for the bearings, and at the same time there is no chance for the oil to work into the commutator or windings. The armature journals are made amply large and the axle bearing bushings correspond. The standard axle of the American Street and Interurban Railway Association can be used.

The gears are made of high grade cast steel and are furnished either in the solid or split type. The pinions are made from high grade hammered steel and are bored taper to fit the taper on the armature shaft. The gear case can be supplied either of sheet steel or malleable iron. The former is preferred, as it combines lightness with strength, and Allis-Chalmers Company has worked out a special construction which does away with difficulties formerly experienced.

The armature core is built up of soft steel laminations carefully annealed and varnished after punching. They are securely clamped between end heads which also have rims to support the coil ends a uniform distance from the shaft.

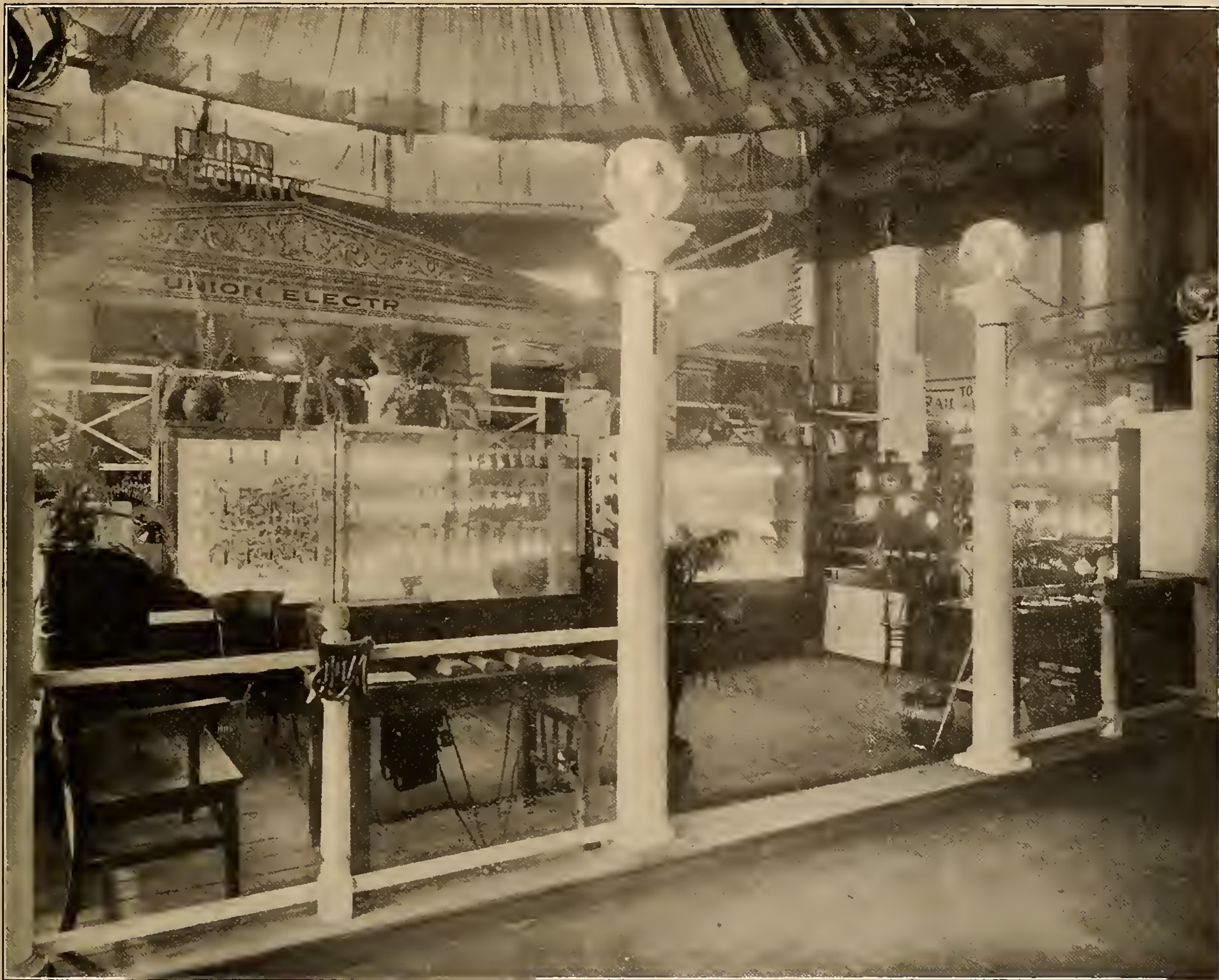
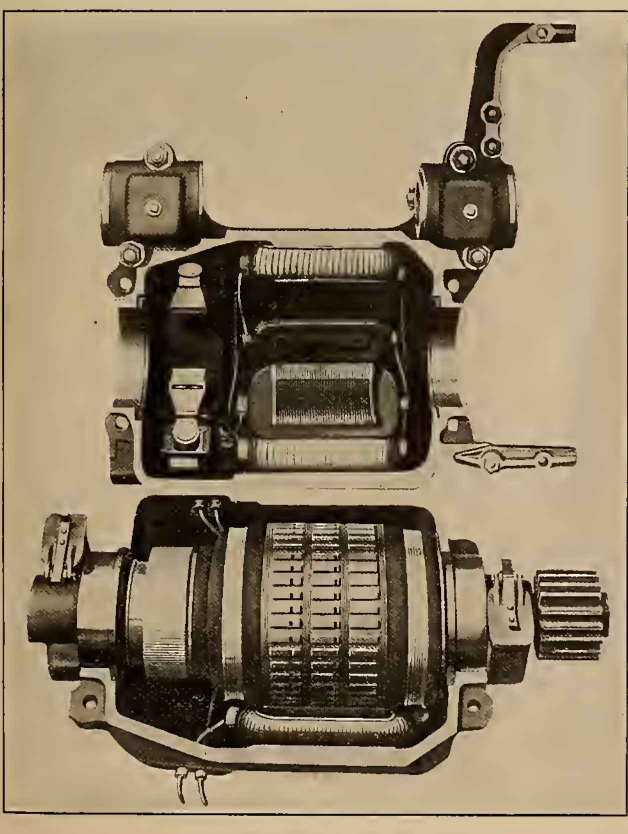


Fig. 3. National Electric Lamp Association at St. Louis, 1910.



New Interpole Railway Motor.

The laminations are built up on a cast spider and ventilation ducts are arranged. The spider also carries the commutator, so that shaft renewals can be made without disturbing the windings. The coils are wire wound and insulated in the usual way, but after being pressed in steam heated moulds are cooled under pressure, which gives each the same dimensions. This makes the coils absolutely interchangeable, which greatly reduces the labor whenever it becomes necessary to rewind the armatures.

Hard drawn copper commutator bars are mounted on a cast steel sleeve. Mica insulation is used between the bars and a one piece mica cone ring is employed. The commutator is carefully constructed with ample dimensions and with creepage surfaces extra long.

Two cast brass brush holders are mounted in the top half field frame. They are each arranged for two carbon brushes held down by spring pressed arms. The holder body is adjustable to care for commutator wear and the brushes are kept in correct position. The brush end of the copper shunt or "pigtail" is so arranged that an exchange of brushes is easily effected.

The 501 motor is rated at 50 h.p. on 600 volts or 42 h.p. on 500 volts. These loads can be carried for one hour with a temperature rise not exceeding 75 degrees C. above the surrounding air. It has a continuous capacity of 36 amperes at 400 volts. The motors are designed for either double or four motor equipment and standard gear ratios are employed.

Allis-Chalmers Company is now building, in addition to the Type 501 interpole motor described, the non-interpole Type 301 rated at 40 h.p., Type 302 rated at 55 h.p. and Type 303 rated at 75 h.p.

NEWS NOTES

FINANCIAL.

JACKSONVILLE, CAL.—A municipal election has been called for the purpose of voting an issue of $30,000 bonds to provide for a gravity water system.

MOUNTAIN HOME, IDAHO.—The voters of Mountain Home will hold an election August 17 to decide on voting bonds for the construction of a system entirely in keeping with the requirements of the underwriters affording the very lowest rate of insurance.

INCORPORATIONS.

PETALUMA, CAL.—The Healdsburg Telephone Company has been incorporated by Eli Bush with a capital stock of $50,000.

NORTH BEND, WASH.—The North Bend Heat, Light, Water & Power Company has been incorporated for $20,000 by Fred E. Sander.

PORTLAND, ORE.—The Pacific Power & Light Company of Augusta, Me., has been incorporated to do business in the state of Oregon, with a capital stock of $7,500,000.

SANTA ANA, CAL.—The Freehold Water Company has been incorporated by W. P. and I. E. O'Meara, E. H. and T. M. Kennard and J. D. Pope with a capital stock of $100,000.

LOS ANGELES, CAL.—The Long Beach Consolidated Gas Company has been incorporated by A. E. Murphy, B. T. Story, H. F. Keenan, H. J. Bauer and L. J. Lee, with a capital stock of $1,500,000.

SAN BERNARDINO, CAL.—The Mill Creek Reservoir Company has been incorporated by W. H. Van Leuren of Redlands, Cal., N. P. Hinkley and J. M. Cole of Bryn Mawr, and J. H. Strait of Redlands, Cal.

SAN FRANCISCO, CAL.—The Merchants' Light, Heat & Power Company has been incorporated by M. D. Levenson, B. A. Goldsmith, W. Lilienthal, V. E. Mathews, A. J. Donovan, S. L. Yehl and J. Greenbaum with a capital stock of $1,500,000.

LEWISTON, IDAHO.—The Clearwater Telephone & Telegraph Company has been incorporated by Sampson Snyder, A. Anderson, F. Jones, J. Decourtesey and J. Fairley with a capital stock of $40,000. The proposed length of the company's line is 200 miles.

TRANSMISSION.

COLVILLE, WASH.—Paul La Plant was awarded the contract to construct an additional electric line from the power house at Meyers to this place.

VIRGINIA CITY, MONT.—It is reported that U. S. Senator Dixon and Spokane capitalists will erect a power plant at Three Forks, at a cost of about $200,000.

VANCOUVER, B. C.—The Western Canada Power Company will shortly award a contract for the 40 miles of ⅜ in. steel cable to be used on the transmission line from Stave river falls to this place.

REDDING, CAL.—On account of the illness of Attorney A. M. McCoy at Red Bluff, the water suit has been continued from August 22 to Sept. 12. This is the case of the power company vs. A. F. Smith et al.

COTTONWOOD, IDAHO.—The Grangeville Electric Light & Power Company has purchased the local light system and franchise. The plant will be improved and 18 miles of high voltage line constructed.

LOS ANGELES, CAL.—In order to protect the city's interests and those of bond buyers two friendly suits are to be instituted within a short time to test the city's legal right to issue and sell the $6,500,000 bonds recently voted by the people for harbor improvements and aqueduct power plants.

BALLS FERRY, CAL.—The ferryboat built by the Northern California Power Company has been completed at a cost of $2500. The boat was built expressly to transport heavy machinery across the river. The machinery is to be hauled from Anderson to the new power house at Coleman, four miles up Battle Creek from this place.

BERKELEY, CAL.—The City Council passed an ordinance granting to the Great Western Power Company, a franchise, to erect, construct, maintain and operate for a period of 35 years, piers, poles, metal masts and other superstructures for conducting electricity along public highways, public ways, etc., for furnishing heat and power.

CITY OF MEXICO, MEX.—Lic Francisco Alfaro has received a telegram from A. B. Adams & Co. of New York, to the effect that the capital of the Balsas Power & Irrigation Company, amounting to $200,000 has been raised and that the work of exploiting the concession which Lic. Alfaro secured from the government for the New York house will begin at once.

JACKSON, CAL.—A party of capitalists from the East representing the syndicate interested in the new power plant to be constructed on the Mokelumne river have been visiting this vicinity under the guide of W. H. Underwood, head of the General Electric Power Co. While in Jackson Mr. Underwood confirmed the report that engineers are in the field making final locations of the ditch line and power site, together with other important work preparatory to construction of the entire system.

TRANSPORTATION,

STOCKTON, CAL.—The Board of Supervisors has granted the Central California Traction Company a franchise through Fair Oaks to the Santa Fe.

SAN FRANCISCO, CAL.—The strike of the linemen on the Northern Electric is not having any effect on the company's time schedule. All trains are running on time without interference.

POMONA, CAL.—Vice-President W. G. Kerchoff of the Pacific Electric Railway, said when he was in Pomona last week that his company will at once begin further construction work in this city.

SPOKANE, WASH.—It is reported that James J. Hill will invade the territory now belonging to the Blackwell interests and the Milwaukee road by building an electric line from a point near Spokane to Priest Lake.

TACOMA, WASH.—A movement for active work toward the building of the proposed new interurban line, which will be over 30 miles in length, connecting Tacoma with Seattle, was made at the meeting of the Seattle-Tacoma Short Line Company. James B. Murphy, Lowman building, Seattle, is president.

STOCKTON, CAL.—Ground has been broken on the Stockton-Modesto electric interurban road near French Camp, south of Stockton, and a camp has been established along the side of the Western Pacific at the Priest place. M. L. Brackett expects to have all of the grading completed in 90 days. Practically all of the rights of way have been secured.

ROSEBURG, ORE.—The Coos Bay Traction Company has announced its intention of beginning within sixty days on construction of a standard gauge electric railway between this place and Coos Bay. Articles of incorporation have been filed for $1,000,000 with the Secretary of State. Geo. T. Averill is president of the company.

ALAMEDA, CAL.—Industrial Agent F. W. Hoover of the Southern Pacific states that the new Alameda County electric service of the S. P. will start operations this coming November. Hoover said that all of the pole lines, save for the High street, connecting loop, were in place. He explained that a delay in finishing the transmission power-house caused the opening of the service to be put off until late in the fall.

SAN FRANCISCO, CAL.—At the last meeting of the Supervisors a resolution was passed to print determining to grant a franchise for a street railroad from the intersection of Parnassus and Third avenues, along Parnassus avenue to Judah street to Ninth avenue to Pacheco street and authorizing the clerk to advertise for bids for the same, and fixing Monday, September 12, as the day for opening the bids and the awarding of franchise.

STOCKTON, CAL.—The last spike has been driven on the Central California Traction line between Stockton and Sacramento, and preparations for the opening of traffic about August 15 are being completed. The connecting link was made near Arno, and the finishing work is now being done. An express service between the two cities in one hour and 45 minutes is contemplated. There will also be an accommodation train, scheduled to make the run in two hours and ten minutes.

ILLUMINATION.

SPOKANE, WASH.—The Spokane Falls Gas Light Company is getting ready to make numerous extensions to its plant.

COEUR d'ALENE, IDAHO.—The Commercial Club is negotiating with the Sessex Construction Company of Atlantic City, N. J., with a view of having that company establish a gas plant here.

LONG BEACH, CAL.—The application of the Pacific Electric Company for a franchise on the harbor front has been withdrawn, the company's attorney saying there was no particular need for it at present.

FALLS CITY, ORE.—W. E. Newson, proprietor of the Falls City Electric Company, is making arrangements preparatory to the construction of a new power house which will be situated about two hundred yards below the plant now in operation.

SAN FRANCISCO, CAL.—The order heretofore made to the City and County of San Francisco to show cause why the Supervisors should not be restrained from enforcing the gas rates against the San Francisco Gas & Electric Company, came up on the law and motion calendar last week in the U. S. Circuit Court. By agreement of counsel the hearing was set for the first Tuesday in September.

THE DALLES, ORE.—The Columbia Power & Light Company which recently purchased the electrical plant and business of the Wasco Warehouse Milling Company will spend $60,000 in improving the electric system in Wasco county. Forty-five thousand will be expended in enlarging and improving the plant at White River falls, while $15,000 will be spent in this city by the concern in making improvements.

MARTINEZ, CAL.—The Richmond Light & Power Company has applied for a franchise to construct, erect, maintain and operate, over, along, across, and upon the county roads, highways, public ways, streets, lanes and public grounds, such poles, masts and superstructures as it may deem necessary to transmit electric current for the purpose of supplying electric current for power to persons. Sealed bids will be received by the Board of Supervisors for the franchise up to 10 a. m., September 6th.

ALAMEDA, CAL.—The city of Alameda is to purchase electric current for day service from either the Great Western Power Company or the Pacific Gas and Electric Company both of which companies submitted bids to the electricity commission. The Great Western concern agrees to furnish the municipality with a minimum amount of 175 kilowatts at a cost of 1c per kilowatt, current in excess of the minimum to cost 1½c. The bid of the Pacific Gas & Electric Company contracts for power at 1c per kilowatt and 3c per kilowatt for emergency energy.

SAN BERNARDINO, CAL.—Asking damages for over a million dollars the San Bernardino Valley Gas Company has filed suit against the Home Gas & Electric Company of Redland, W. R. Cheney, J. F. Dostal, C. S. Chestnut, Pacific Light & Power Company, San Bernardino Gas & Electric Company, a branch of the Pacific company, the First National Bank of Redlands, H. B. Duncan, Walter M. Camphell, Payton H. Moore and L. Cruickshank, W. G. Kerchoff, and A. C. Balch. The complaint charges that the defendants by filing a petition in bankruptcy sought to ruin the plaintiff company's business and credit. For general and actual damages sustained, the plaintiff asks judgment for $500,000; for punitive damages caused by the alleged malicious acts of the defendants the sum of $500,000 is asked and $3500 is demanded for costs of suit.

WATERWORKS.

MERIDIAN, ORE.—The village board of Meridian has let contracts for furnishing the iron tank and frame and also the pipe for the waterworks system.

SAN JOSE, CAL.—Bids have been ordered advertised for water pipe to be used in the construction of a water system on the Pacheco Pass road for road purposes.

SPOKANE, WASH.—Negotiations are now going on between the Washington Water Power Company and the Lewiston-Clarkston Investment Company of Lewiston, Idaho, for the construction of a power line between this place and Lewiston.

EL PASO, TEX.—The City Council has made a demand upon the International Water Company to install at once improvements to its system in the shape of new mains, pipes, fire hydrants, valves and valve boxes which the city engineer estimates will cost $25,000.

SAN FRANCISCO, CAL.—The construction of the fire protection mains leading from the Twin Peaks reservoirs to the initial center of the fan shape distribution system of pipes at Castro and Scott streets, has been awarded by the Board of Works to the Raisch Improvement Company for $44,205.40.

HILLYARD, WASH.—Plans for a new reservoir to supply the city of Hillyard with water are now on foot by members of the city council. According to the proposition now under consideration a reservoir having a capacity of 1,000,000 to 1,500,000 gallons will be built in Berg's addition, formerly set aside for a dump ground.

SEATTLE, WASH.—This city has begun condemnation proceedings for the acquisition of 35,000 acres of land in the Cedar River watershed, comprising all of the land not government land which the city does not now own in the watershed. When the condemnation proceedings shall have been finished the city will own 70,000 acres between the city and the summit of the Cascades, and will have full control of all the drainage naturally emptying into the Cedar River. The tract is to be acquired for the purpose of protecting the city's water supply from pollution.

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 8 | SAN FRANCISCO, AUGUST 20, 1910 | PER COPY, 10 CENTS

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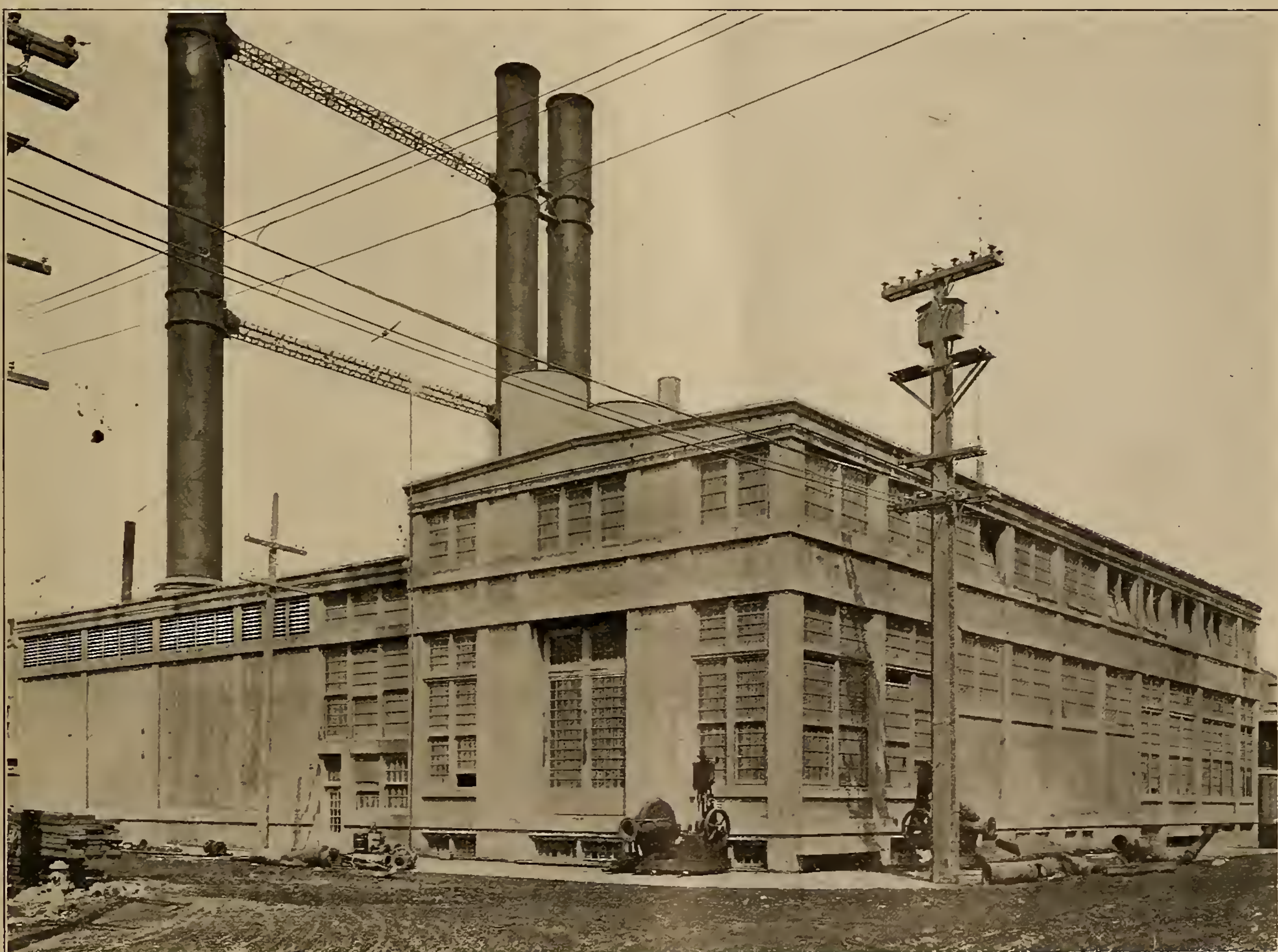
POWER SYSTEM OF THE CITY ELECTRIC COMPANY

BY J. G. DE REMER AND CHAS. W. BAKER

The steam power plant of the City Electric Company of San Francisco stands as a concrete example on the affirmative side of the argument on steam versus hydraulic power in California. Coming into existence, as it did, shortly after the great conflagration of 1906, this company has grown up with the new city, until it possesses at the present time a generating station and distribution system of the most modern type, now being the largest on the Pacific Coast. Furthermore, the generating station is an excellent illustration of the remarkable development of the modern steam turbo-generator, the entire station being equipped with this type of machine.



Power House of the City Electric Company, San Francisco

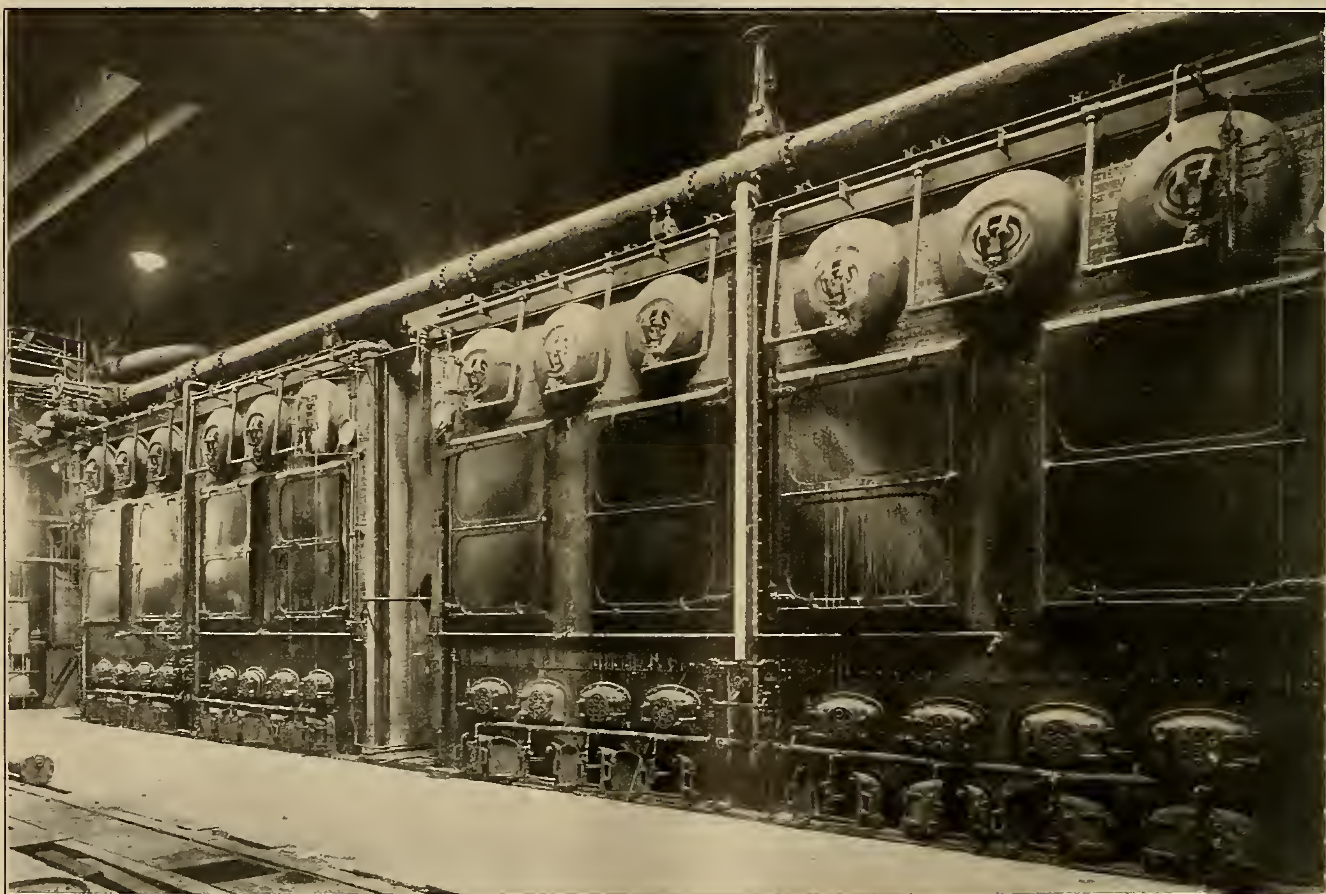
The power house is at the corner of Beach and Mason streets, San Francisco, immediately adjacent to the bay where the Golden Gate guards the entrance to San Francisco.

The building is constructed of reinforced concrete, is 137½ ft. square and approximately 40 ft. high. The turbo-generator room is 46 ft. by 137½ ft.

Within this space has been concentrated 30,000 kw. of steam-electric generating capacity, in addition to the controlling switchboard and circuit breaker equipment, as well as the exciter. This represents an average of .21 sq. ft. of floor space per kw. Where a power plant stands on valuable city property, as in this instance, this feature of compactness is a most desirable one, and in this respect the steam turbo-generator excels all other types of power generators.

Boiler Room.

The boiler room is equipped throughout with Babcock and Wilcox water tube boilers. The original installation was made up in batteries 21 rows wide and 14 rows high, while the later installation is made up in batteries 24 rows wide and 14 rows high. The accompanying photograph shows the arrangement of the boilers and the ample space which is available for operation, repair work, and general cleaning. Each boiler is equipped with a Babcock and a Wilcox superheater giving from 50 to 60 degrees superheat, the principal purpose being to ensure dry steam for operating the turbines, rather than to obtain a higher efficiency due to a greater temperature range as is usually desired when superheating is adopted.



Boiler Room

Fuel Supply.

The fuel is supplied through pipes leading direct from two storage tanks. These tanks are situated, one 500 ft. away and the other one 1000 ft. away from the power house, one being about 50 ft. higher than the boiler room floor and the other approximately on the same level as the floor. The fuel tank nearer the power house has a capacity of 10,000 bbls., while the other has a capacity of 30,000 bbl., 42 gals. per bbl. The fuel is delivered to these tanks directly from oil floats or vessels, being pumped into the tanks by the vessel pump. An 8-in. buried pipe conveys the fuel from these tanks to the street line of the power house, where it is reduced to a 6-in. pipe, which conveys it directly to the fuel pumps. This latter pipe is steam-jacketed, exhaust steam from the fuel pumps thus heating the oil before it reaches the fuel pump. After going through the fuel pump the fuel is heated in a special heater which was built by the City Electric Company. This heater consists of a steam tank through which passes a coil carrying the oil. This causes but slight back pressure upon the exhaust of the auxiliary, and is considered one of the unique features of the plant. There are two of these heaters, having an area of approximately 300 sq. ft. each. After passing through these heaters the oil goes through a separator, made by the City Electric Company, and consisting of an 8-in. pipe approximately 16 ft. long, inside of which are fitted baffle plates. The oil then goes directly to the burners under a pressure of about 60 lb. per sq. in.

The amount of fuel admitted to the burners is controlled by a Witt diaphragm regulator on the throttle valve of the fuel pump. This regulator will vary the pressure approximately 20 lb. per sq. in. It is controlled by the variation in boiler steam pressure. Since such a large variation in oil pressure is controlled by the regulator, but one fireman is necessary to attend to the whole battery of boilers, his attention only being necessary when the pressure limits exceed the above

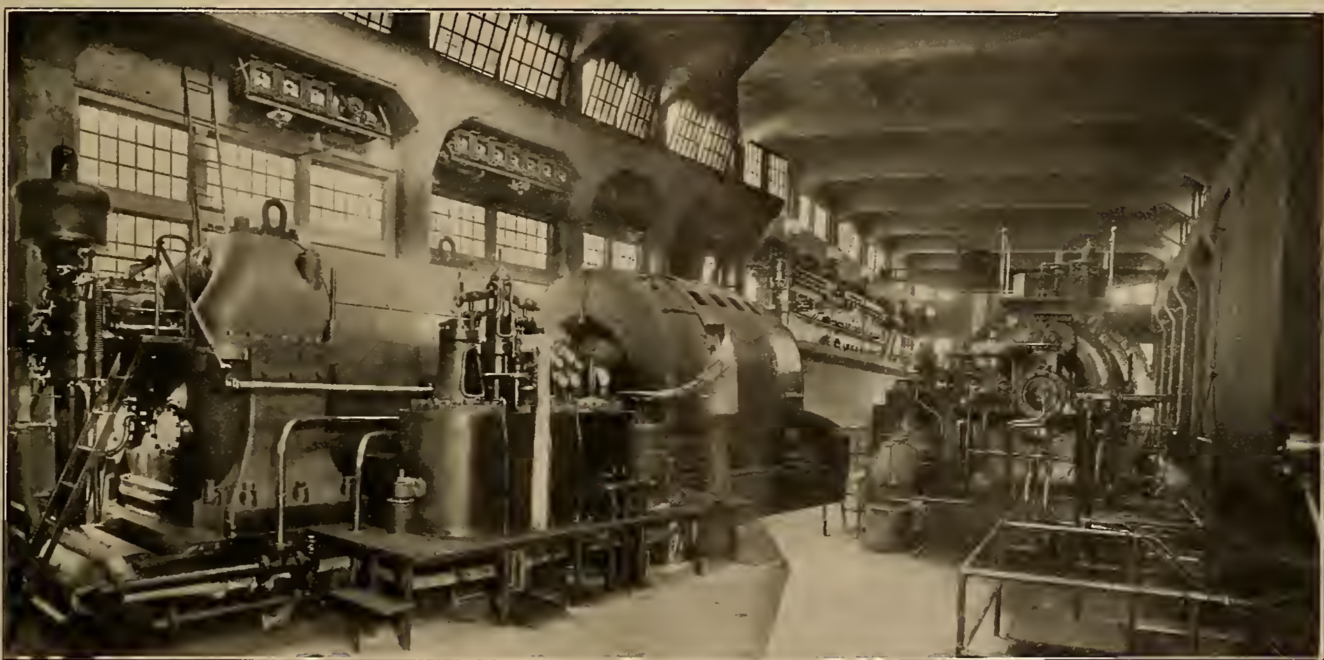
mentioned variation. The oil on reaching the burners is at a temperature between 160 and 180 degrees F. The burners are of the Leahy type made by the Leahy Manufacturing Company, of Los Angeles, the fire burning from the rear towards the front of the fire box.

Feed Water Supply.

The feed water is supplied directly from the city mains and from a well near the fuel tanks, about one-half of the make-up water being taken from the well. The feed water is passed through Cochrane heaters and brought up to a temperature of 180 degrees F. before entering the boilers. While the water is not hard on the boilers it is treated with tri-sodium phosphate before going into the boilers.

The feed pump equipment consists of two marine type duplex pumps; one a horizontal, duplex outside packed Scranton type Worthington pump, and the other a vertical marine type fire and general service pump which can be used as a feed water pump, or if necessary as a fire auxiliary. There is also a 5 in. turbine driven pump consisting of Kerr steam turbine direct connected to a Janesville Iron Works four-stage centrifugal pump. This pump has a capacity of 700 gallons per minute against a boiler pressure of 250 lb. per sq. in. It has been found that these centrifugal turbine driven pumps have a higher efficiency than the duplex reciprocating pumps, the efficiency being approximately equal to that of a single cylinder, non-condensing engine. These four feed pumps take water directly from the heater and are controlled by butterfly throttle valves in the steam pipes which are, in turn, controlled by the water level in the heaters.

The boilers lead directly into steel headers and from there piping leads out to the various turbines. Solid drawn steel piping is used throughout, expansion being provided by loops. The piping used in the plant was manufactured by the Best Company of Pittsburg.



Turbo - Generators

The original plant was designed and erected by Chas. C. Moore & Co., engineers, of San Francisco, who also furnished the boilers, pumps, piping and auxiliary apparatus for the additional units.

Turbine Room.

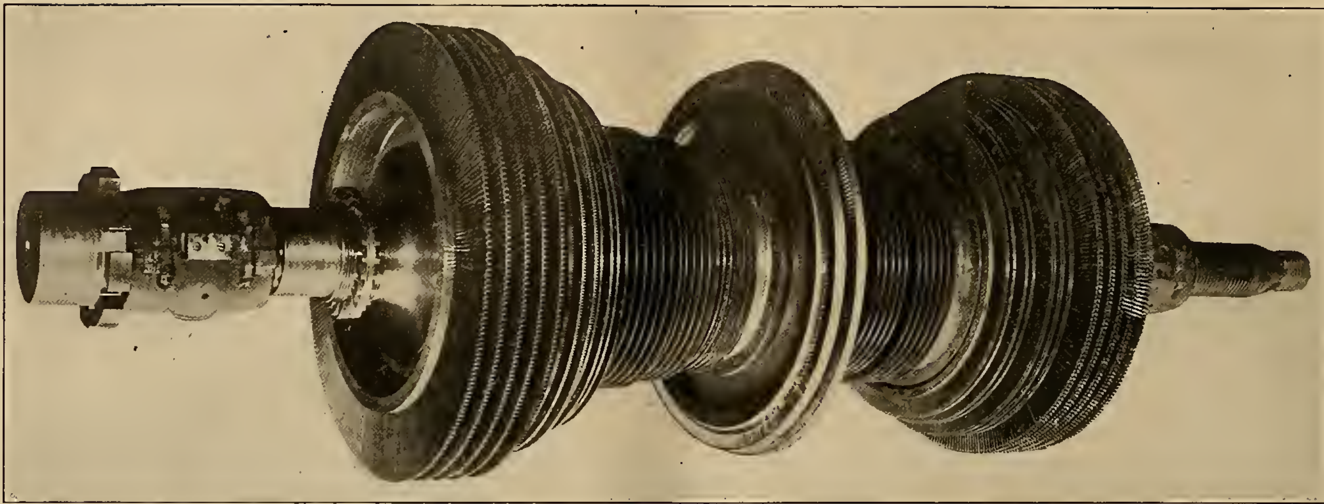
The main generating units are two 3000 k.v.a., one 9000 k.v.a., and one 15,000 k.v.a. Westinghouse-Parsons horizontal turbo-generators. All of these units were installed by Hunt, Mirk & Co., Inc.

The first two units were installed in August, 1907, and are of the parallel flow reaction type. Their characteristics are: 3000 k.v.a., 60 cycle, 11,000 volts, 1200 r.p.m., three phase, four-wire, grounded neutral, the turbine operating on a steam pressure of 175 lb. per sq. in. at the throttle, 28 in. vacuum. The steam is super-heated to approximately 45 degrees F.

The second unit installed was a 9000 k.v.a. Westinghouse single double flow turbine with the same characteristics on the generator end as in the 3000 k.v.a. units. The only difference in construction appears in the turbine end, where the steam enters in the center and expands first through an impulse element, known as the high pressure cylinder; it then passes through the intermediate section of blades at the end of which section the steam is divided, part going through the spindle body, supplying the low pressure blading at one end, while the remaining part goes directly on through the low pressure blading at the other end.

The last unit installed is one of the largest single steam turbine units in the United States, being rated at 15,000 k.v.a.. It possesses some marked improvements in design, more particularly in the high rotative speed ratings employed, namely, 1800 r.p.m., which is a distinct advance for units of this capacity.

The value of high speeds for obtaining the best ecomomies with turbines has always been recognized, while the feasibility of operating at high speeds has been viewed with uncertainty by those interested in



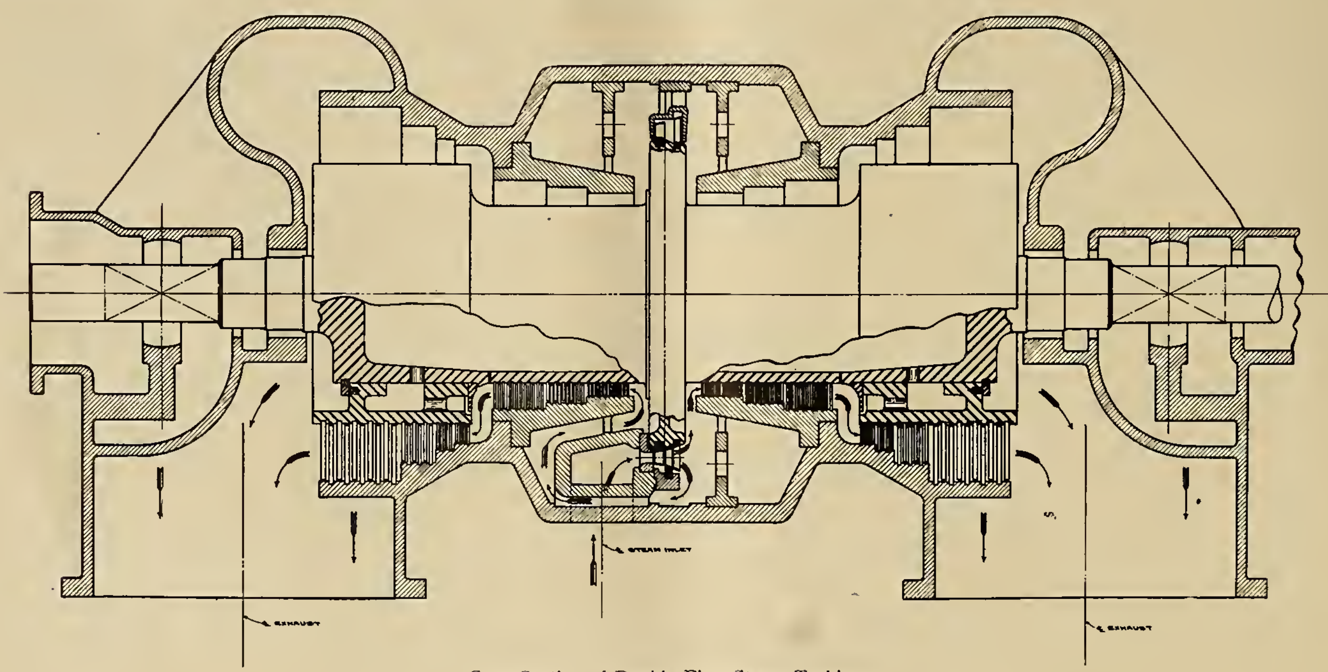
Rotor of Westinghouse-Parsons Turbine

turbines, except the designer. It has been with the characteristic double-flow turbine that the use of increased speeds has been made practical. A typical section of the machine installed shows that the steam entering at the center flows in two directions, as the name implies. Hence, with the steam thus divided, the necessary steam passage at the low pressure ends is accordingly reduced. It is evident that the same peripheral speed may obtain in case of either the high or the low rotative speeds. Generally where the peripheral speeds are made to correspond in any two types, the centrifugal stresses should not differ. But the smaller rotor of the higher rotative speed, containing less mass, may be cast or made of greater integrity, and there will invariably exist a higher factor of safety in high rotative speed units.

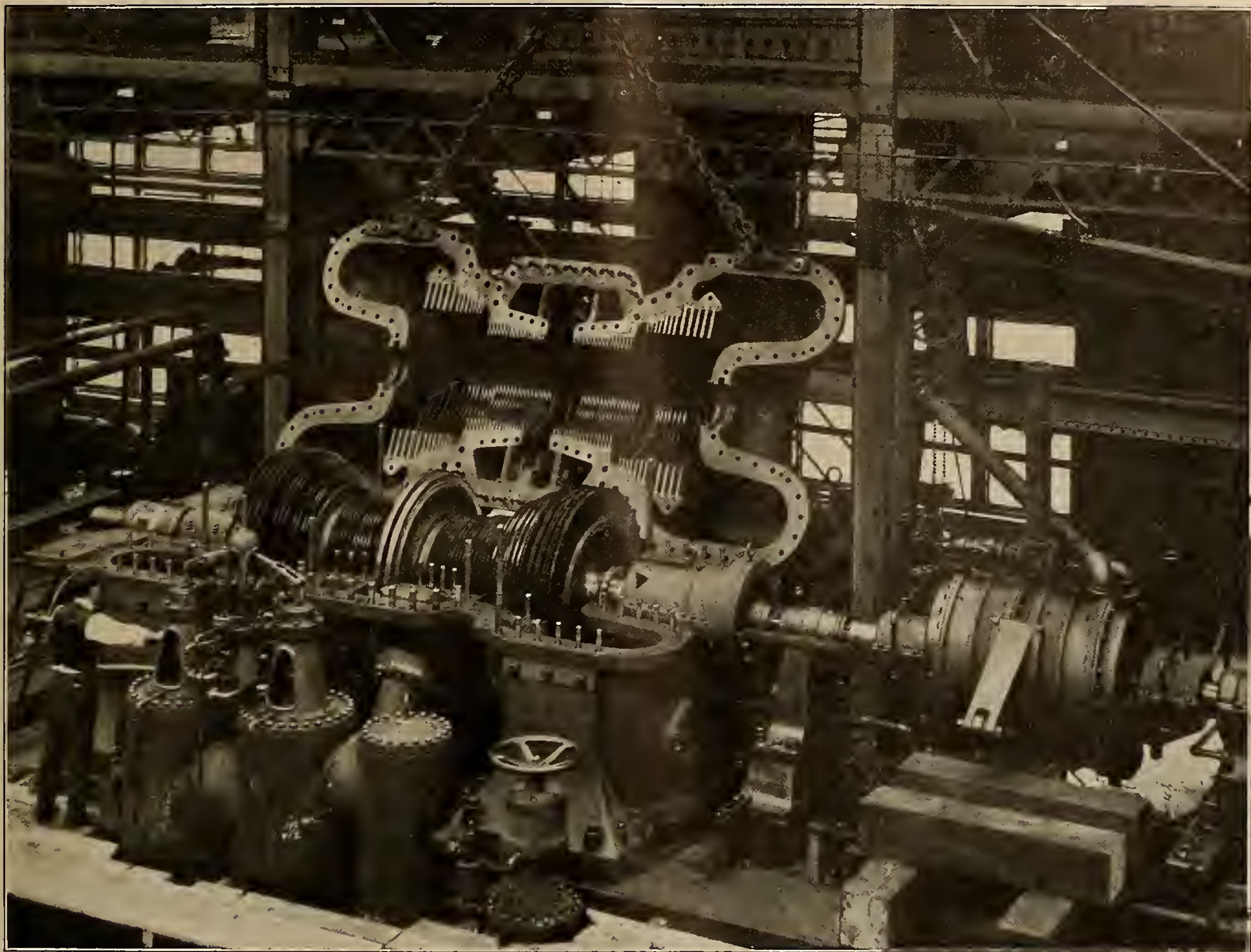
An impulse wheel is used at the high pressure end. Both intermediate and low pressure stages are double-flow, dispensing with the dummy pistons occurring in single reaction turbines to balance the axial thrust. Steam after being directed upon the impulse section by the expanding nozzles provided, divides, part expending its energy in passing through the right element and the remaining half being diverted to the left through the steam path circumventing the impulse wheel.

The symmetry of structure necessary for large capacities in order to avoid disproportionate exhaust ports or widely varying sectional dimensions, which would produce unwieldly and cumbersome castings has been amply fulfilled in this design. A rotor view accompanies. Similarly, the cylinder presents a corresponding appearance. These facts are emphasized strikingly in the illustration of a shop view of the unit after it has been tested at the builder's works and opened up for inspection before shipment.

The redistribution of steam and the ability to utilize more efficient blade proportions in the high rotative speed designs, has manifestly secured the very highest performance results. Recent demonstration tests have confirmed the value of these particular features of the design, and a thermodynamic efficiency of 69 per cent at the generator terminals was obtained, which excells any other steam motor record known. The principle data of the test will be published shortly in these columns.



Cross-Section of Double Flow Steam Turbine.



City Electric Company's 15,000 k. v. a. Turbine in Westinghouse Shops.

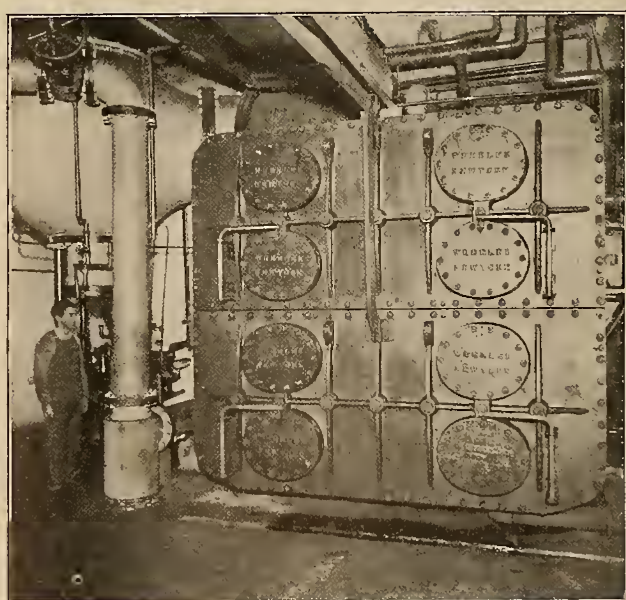
The machine is designed to operate normally at 175 lb. steam pressure, 100 degrees superheat and 28 in. vacuum. A four-pole rotor is employed in the 60-cycle three-phase generator coupled to the turbine. It is of steel casting made in halves and held securely by through bolts. The shaft ends are cast integral with each half of the rotor drum, which proves to be substantial construction for the high speed for which through shaft designs would not serve in large units.

The exciter for this machine is mounted upon a pedestal beyond the main bearing and is direct connected to the end of the generator shaft. It is a 75 kw. d.c. inter-pole generator of the same operating characteristics as the exciters for the other units. This latter feature permits all exciters being thrown on to the common bus-bars and makes possible their control by one Tirrell regulator.

The main turbine room is equipped with a 30-ton crane manufactured by the Cyclops Iron Works.

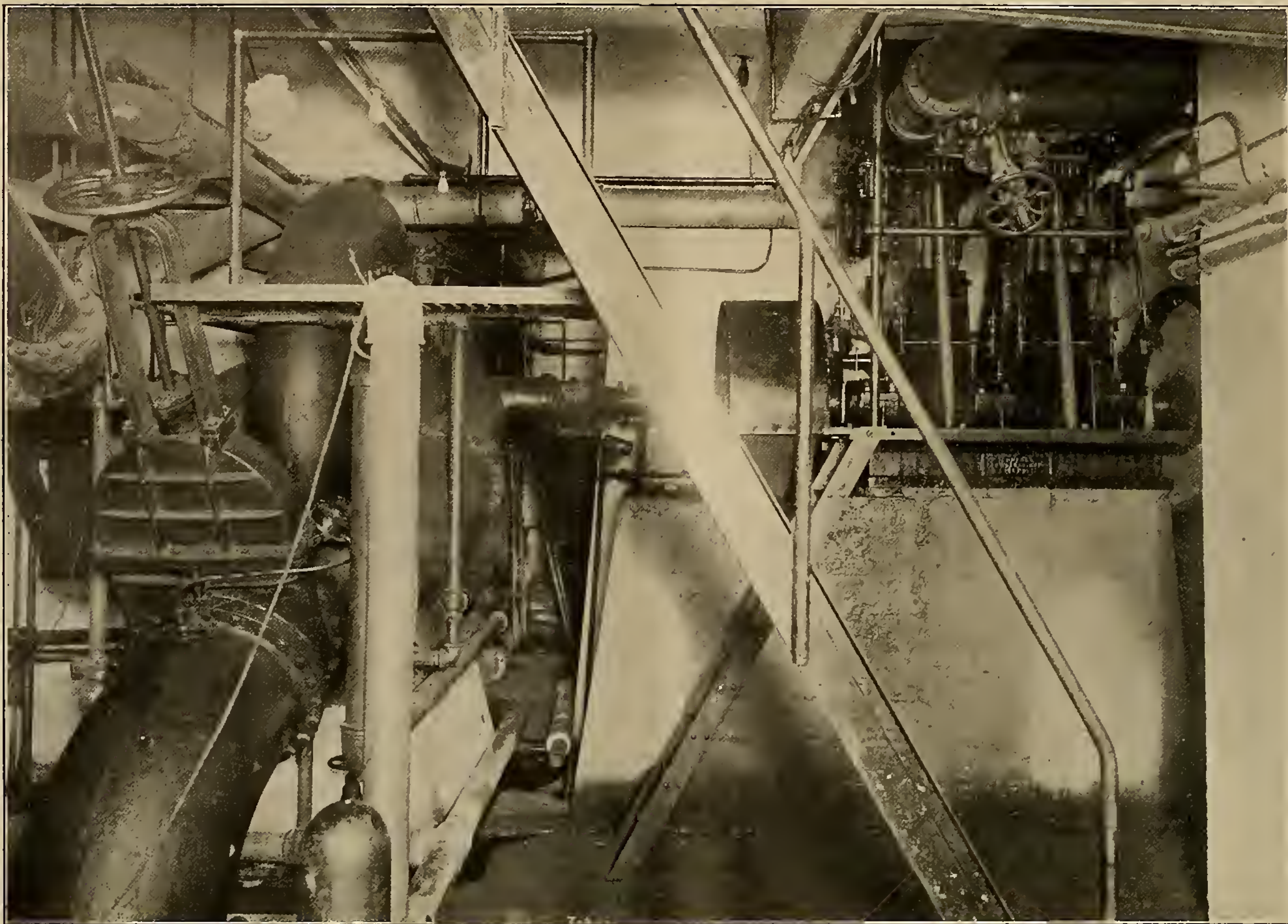
Condensers.

The vacuum of the turbines is maintained by Wheeler condensers. There are two condensers of 7500 sq. ft. area each; one of 18,000 sq. ft area, and one of 25,000 sq. ft. area. The circulating water for these condensers is taken from the waters of the San Francisco Bay, 550 ft. from the power house. It is brought in through a 42 in. pipe, which was installed below tide level and pitches toward the station. The circulating water for the two smaller condensers is supplied by a Kerr turbine, direct connected to a centrifugal pump. This turbine has a rating of 150 brake h.p. at 750 r. p. m. The pump has a 20 in. discharge pipe and a 24 in. suction pipe.



Condensers

For the intermediate condenser, the circulating water is supplied by a pump which is direct connected to a vertical double acting Lawrence Machine Works



Centrifugal Salt Water Circulating Pump and Engines with Chapman Gate Valve in Suction Line.

engine. The pump has a 30 in. suction and 24 in. discharge. The engine is 11 x 10 in., single expansion, two cylinders.

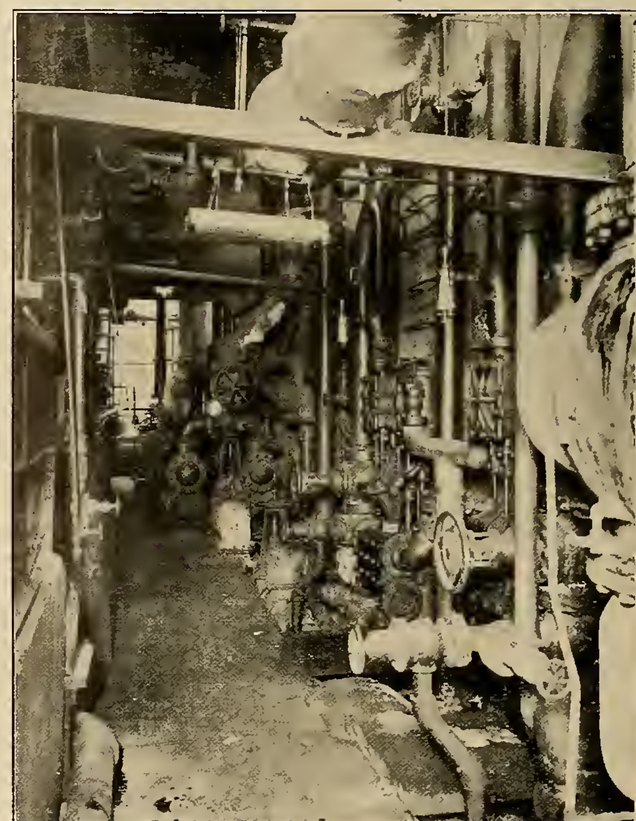
For the large condenser, the circulating water is provided by a Harrisburg Foundry & Machine Works 15 x 17 in. piston engine, operating at from 175 to 250 r.p.m. and direct connected to a centrifugal pump. This pump has a 36 in. suction by 30 in. discharge pipe.

The condensers are so situated that their center lines in each instance are perpendicular to the center lines of the turbines to which they are connected, and they are placed in the basement directly under their respective turbines.

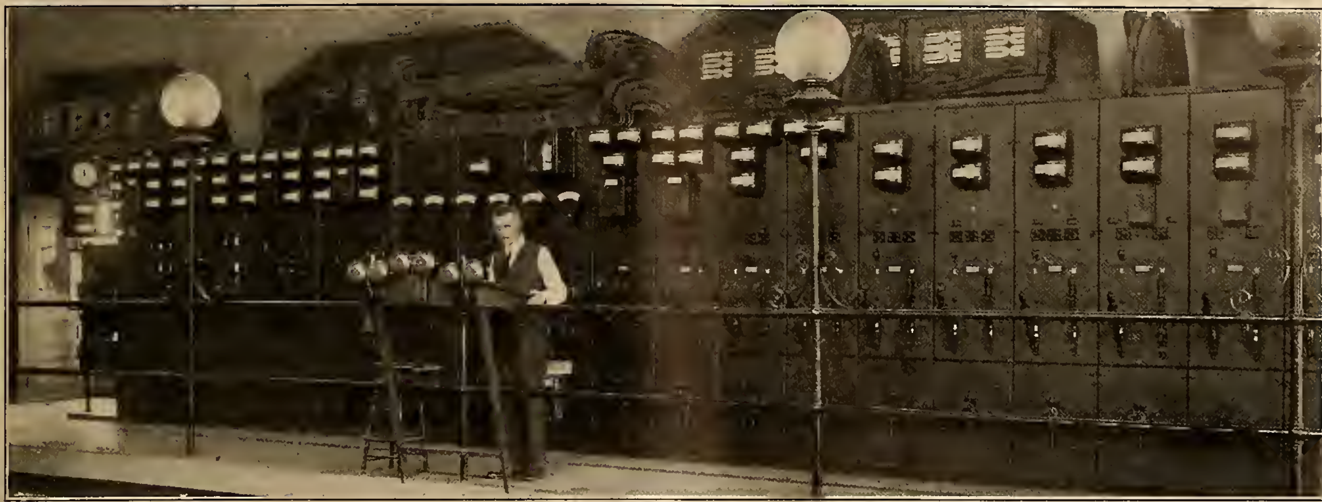
The exhaust from all of these pumps and pumping engines is condensed in the fuel and feed water heaters. The condensers operate on the wet and dry system, there being an independent dry air pump for each condenser, as well as independent hot well pumps. These latter pumps are all reciprocating with the exception of the hot well pump, which takes care of the large condenser. These pumps are all manufactured by the Wheeler company.

Exciters.

The excitation for the turbines is furnished by one 100 kw. horizontal, 2400 r.p.m. Curtis type d.c. turbo-generator; one Westinghouse 75 kw. motor generator set consisting of a type CCL, 100 hp., 690 r.p.m. motor, direct connected to a type "S" 75 kw. generator; the two machine being mounted on a common bed plate. On the



Alley Connecting Boiler and Turbine Rooms, Shower, Heaters, Pumps and Pipe Connections.



Switchboard.

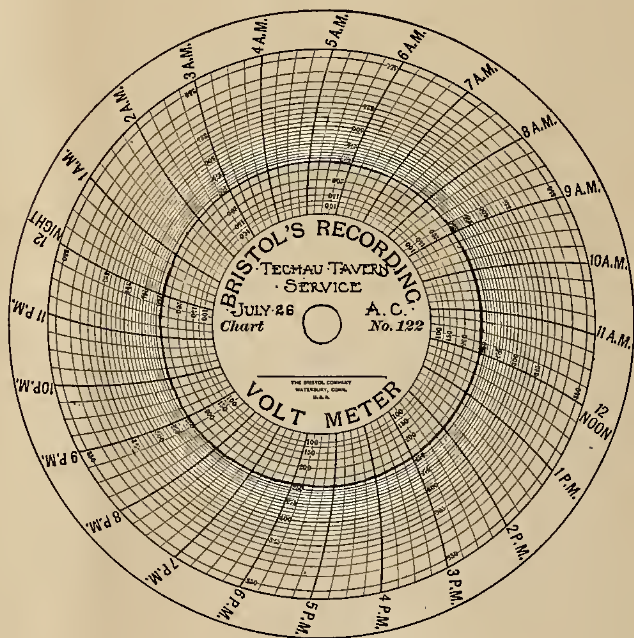
main frame of the large turbine there is a direct connected 75 k.w. Westinghouse, 1800 r.p.m. d.c. generator. The switchboard mounting is such that either of the first two mentioned exciters may be connected direct into any of the three above mentioned turbines, or all three exciters may be operated in parallel, exciting all four turbines at the same time.

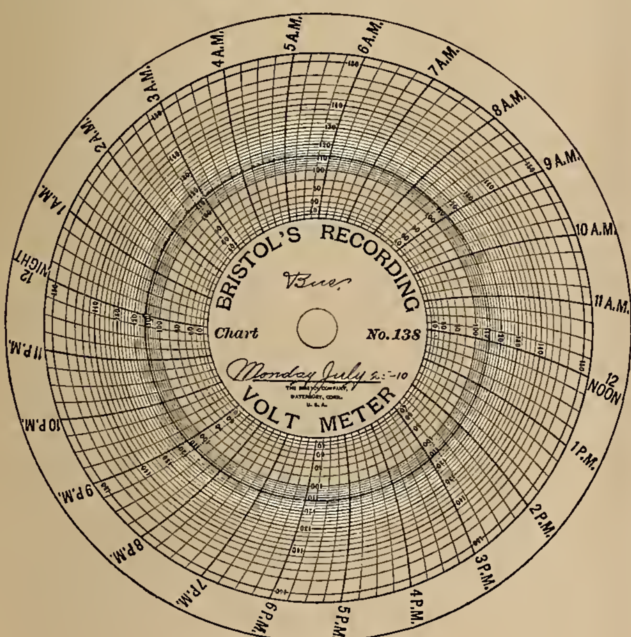
Switchboard.

The switchboard is mounted on an elevated gallery over the circuit-breaker compartments. It consists of seventeen panels, as follows: Four generator panels, three exciter panels, four three-phase feeder panels, and six single-phase panels operating double bus bars. All oil switches are in reinforced concrete compartments underneath the switchboard gallery. These are 15,000-volt, type "F," form K-4, 300-ampere, General Electric oil switches. These switches are manually operated but are provided with overload series relays of General Electric manufacture, type B-2 and type C-2. Generator panels Nos. 3 and 4 are provided with remote control 600 and 800-ampere switches. It is to be noted that the highest voltage on the switchboard gallery is 220 volts.

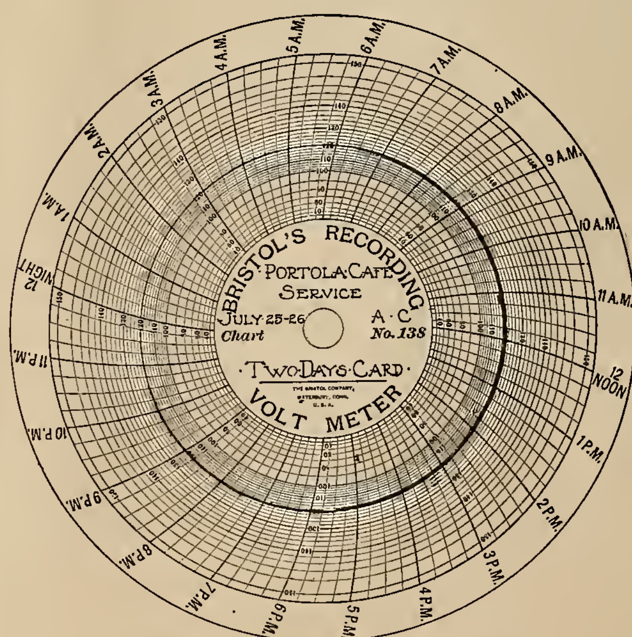
Regulators.

The regulation of the plant is controlled by a 7-point type "DA," form F-7 Tirrell regulator. The





Voltage Curve at Bus Bar,



Voltage Curves at Two Centers of Distribution.

accompanying reproduction of the curves of the voltage at the bus bars under normal operating conditions show that an exceedingly good regulation is obtained.

The outgoing feeders are controlled by six single-phase, automatic induction type regulators of General Electric manufacture, being designated as type I.R.S. These regulators are adjusted for constant potential at the centers of distribution. The accompanying Bristol charts indicate voltages taken from two prominent centers of distribution and show the remarkably constant voltage which is maintained even though the load is fluctuating considerably. These feeders are fed by the same buses that supply the railway load mentioned below.

Distribution System.

Leading out from the power house are two main circuits consisting of three No. 2 copper wires with a neutral of No. 1 copper. The distribution is at 11,000 volts, three-phase, four-wire, and runs overhead from the power house to Stockton and Bush streets and thence underground to the sub-station on Grant avenue between Sutter and Bush streets. There is also a similar circuit running via Chestnut, Laguna and Bush streets, through the Mission district out as far as Fifteenth and Harrison streets. This is a single circuit consisting of four wires of No. 1 copper. These lines, together with the interconnecting service lines, form a closed network, through which the service can be supplied in either direction. On these outgoing mains there are switches at each branching street from which single-phase feeders and the neutral run out for distribution.

There are also two circuits running between the United Railroads North Beach power house and the City Electric main power house, these circuits consisting of three 0000 copper each. There is no neutral run between these stations. These circuits supply the motor generator sets through which the United Railroads receive a portion of their energy.

At convenient points throughout the city, manholes and subway compartments are arranged in which are placed the manhole subway type transformers. These transformers reduce the voltage to 220 and 110 volts for customers' use.

The City Electric Company manufacture their own disconnecting oil switches and have developed a highly efficient and extremely simple type of switch.

Motor Service.

Two-phase motor service is furnished in nearly all cases, use being made of the Scott connection or a modified T connection, through which the company ingeniously obtains the proper quarter-phase voltage. This latter arrangement consists of placing an 11,000-volt to 220 and 110-volt transformer directly across the 11,000-volt mains, and a 6400 to 220-110volt transformer between the remaining main and the neutral. It will be observed that the secondaries are then of the same voltage and at right angles in their phase relations. By distributing such transformer stations around the system, using in each case a different main for connecting the neutral transformer, the whole system remains well balanced.

Sub-Station Switchboard.

The direct current distribution is from the company's sub-station at Bush and Grant avenue. This station consists of three 500-kw., 11,000-volt, three-phase, alternating current, 600 r.p.m. Westinghouse synchronous motors, each direct connected to two 250-kw., 250-volt, direct current generators. One generator of each set is of the three-wire type, thus giving the sub-station the advantage of distributing 120, 240, or 480 volts. These machines are each started with a 37½-h.p., two-phase, 220-volt induction motor, wound for a speed slightly higher than the operating speed of the set. This motor is direct connected to the end of the common shaft.

These machines are controlled by three direct current generator panels and three a.c. motor panels.

The direct current distribution is controlled by eleven feeder panels protected by General Elctric circuit breakers. The alternating distribution from the sub-station is controlled by nine single-phase feeder panels, and one three-phase feeder panel.

Local Distribution.

The direct current feeders consist of two 750,000 circular mil mains with one 500,000 circular mil neutral, in addition to several circuits consisting of two 500,000 circular mil mains with 300,000 circular mil neutral. The 110-volt cable is a 4/0. single conductor, lead-covered cable and is carried along with each feeder.

The general offices of the City Electric Company are on the main floor, directly over the sub-station at Bush and Grant avenue. The offices are conveniently arranged for the accommodation of customers and the transaction of the routine business of the organization. The same policy is in evidence in the office arrangements, which maintain throughout the entire organization, viz., that usefulness and a general high efficiency, is the criterion governing the operation of all departments.

HONGKONG WANTS WIRELESS.

In stating that great interest has lately been taken in Hongkong in the question of wireless telegraphy, Vice-Consul-General Stuart J. Fuller states that those interested in merchant shipping desire that a commercial wireless station be established in Hongkong, and the Chamber of Commerce and many influential residents in the colony have strongly urged it. A proposal was made last fall by an American company to establish a wireless station here to do a commercial business. They were prepared to put in a first-class installation, capable of communicating with Manila, Singapore, Shanghai and Yokohama, and though they did not believe that the station would be profitable for some time they were prepared to bear the early losses in consideration of a license giving them the sole right to conduct a commercial wireless telegraph business for 25 years, with the proviso that the government should have the right to purchase the station and business at a valuation at the end of 10, 15, 20 or 25 years. The propostion was referred to the Colonial Office in London, but was not accepted. At present there are no facilities in the colony for handling commercial messages by wireless, although the American, German and Japanese mail steamers calling at the port are being equipped with the apparatus.

PETROLEUM LUBRICATING OILS.[1]

BY PAUL W. PRUTZMAN.

In these days, when lubricating oils are practically all of mineral origin, we are first interested in the production of the crude oil. Petroleum is produced from holes drilled in the ground, in various places where oil is known or supposed to exist. In this country most drilling is done by means of the standard rig, which consists essentially of a string of tools, a cable, a walking-beam by means of which the tools are given an up-and-down motion, and a plain slide-valve engine of 25 to 30 h.p. connected to the walking beam by means of a crank with adjustable throw.

The string of tools consists of the bit, a sort of blunt chisel, with a width of face equal to the diameter of the hole to be drilled, length ranging from 5 to 10 ft., and weight running often into many hundreds of pounds. Above this the jars are attached by means of a coarse taper thread, usually ¼ in. U. S. S. and a taper of 1 to 4. The jars are a pair of slip shackles with an end play of about twelve inches, and at the upper end are screwed to the stem, which is a long steel bar used as a weight.

This drill is a churn drill, and pounds its way into the ground, being given a vertical reciprocating motion by the walking beam. On the down stroke the weight of the stem collapses the jars, and strikes the bit a hammer blow, while on the upstroke the stem jerks the bit free.

Manila rope is used for drilling shallow holes, and wire line for deep holes, the rope being attached to the tools by a rope socket, and at the upper end to the temper screw by a slip socket. The temper screw is a swivel screw for lowering the tools away from the beam—as the hole becomes deeper the tools are lowered to keep them on the bottom, and when the length of the screw (five feet) is run out, the beam is stopped, the socket slipped up on the rope, and the screw run back to its upper end. The reciprocating motion of the tools in drilling is from 3 to 5 ft., and the beam runs about 30 strokes per minute.

Water is kept in the hole at all times, and the drillings work up to a mud, which is removed from time to time by means of the bailer. This is a long tubular bucket with a flap valve in the bottom, which is lowered into the hole by a small wire line called a sand line. Reels and suitable bull-wheels, brakes, etc., are provided for raising and lowering the tools and bailer.

As soon as a small amount of hole is made, the casing is started into the hole, being screwed on at the top and lowered or forced down as the case may be. The first and largest string of casing is usually of light weight, and known as stove-pipe. The smaller sizes are either screw casing, about the weight of ordinary black pipe, or drive or line pipe, both considerably heavier. These pipes must have very perfect threads—some brands have taper threads like gas pipe, others have parallel threads and butt inside the collar. Each string of pipe is put down as far as it will go, or as far as safety permits, and then a smaller size is put inside, so that often a deep well is finished with four or five strings of pipe in it, each starting from the top of the hole, but only the smallest going to the bottom. The inside string is carried right through the oil sand and into the clay or shale below, and the last step is to punch this casing full of holes where it passes through the sand, so as to allow the oil to enter the casing. If the casing were left open at the bottom, not only the oil, but also a great deal of sand would enter, and the pump could not handle it, so the perforations are used as a strainer, to hold back the sand.

The oil which flows into the casing is pumped out through the tubing, a string of ordinary black pipe 2, 2½ or 3 in. in diameter, long enough to reach the oil level. At the bottom of this tubing is the pump, a plain working barrel with a ball valve at the bottom, and a similar valve in the plunger. This pump, of course, is single acting. The plunger is actuated by a string of ¾ or ⅞ in. steel rods, attached at the upper end to the walking beam. In pumping a much shorter stroke is used than in drilling, and the beam is run slower, being adjusted to keep the oil at some certain level in the casing. When anything goes wrong with the pump it is necessary to raise tubing and rods a stand at a time (a stand is the greatest length which can be handled in the derrick, usually three 20 ft. points), which are unscrewed and stood up in the derrick until all is out. Pulling the tubing and rods from a deep well is a heavy job.

A few wells flow naturally, but most must be pumped—in some fields many wells are pumped by means of air, in a manner similar to water pumping. The average production of wells in California was said, about a year ago, to be near thirty barrels per day, though I would consider this a little high. In some fields wells may be profitably pumped when they give as little as one barrel per day, but this is under the most favorable conditions. In some territory the minimum of profitable production runs as high as 100 barrels.

The oils of this state run all the way from 12 to 35 degrees in gravity, but most of the oil which is refined is 21 degrees or lighter. These oils give as products, gasoline (64 degrees), benzine (57 degrees), engine distillate (52 to 48 degrees), kerosene (42 to 41 degrees), stove oil (34 degrees), various lubricating oils and asphalt.

Distillation.

The first step in the actual manufacture of lubricating oils is the distillation of the crude. The still is a horizontal boiler, without tubes or other internal contrivances except a perforated pipe or series of pipes along the bottom, by means of which either wet or superheated steam is blown into the oil. The still is connected to a surface condenser, usually square coils of iron pipe, or often a battery of coils in parallel. The condensed vapors run through a sight box, a steel box with windows through which the stream of oil may be seen, and are distributed by a battery of valves to the various running tanks.

Distillation is by open fire in a plain firebox. The first distillate is the lightest, and the oil running from the condenser becomes heavier as more is taken off. The stock from which the lubricating oils are made is the last which is taken from the still, and is of about

[1]Address before Cal. No. 3, N. A. S. E. August 10, 1910.

20 degrees gravity, and of a green-red color. That is, it is green when viewed in a mass, but red when looked through in thin layers. The color when fresh from the still is much lighter, from straw to amber, but this darkens within a few hours. The residuum left in the still from distillation of crude is asphalt, the hardness of which will vary with the amount of distillate taken off.

Refining.

The lubricating stock is now pumped back to a clean still, and is again boiled and steamed until a proper amount is taken off. The distillate from this run is partly fuel oil, partly stock for very light lubricants, such as ice machine and neutral oil. The residue in the still, which is known as reduced stock, is thicker and heavier than the raw lubricating stock, and a little darker in color. Ordinary green oil or skid oil is an example of a reduced stock.

The gravity to which the stock is reduced depends on the kind of oil to be made, and the refiner's ideas as to treatment, but is always lower than the gravity of the finished oil, as the stock loses in both gravity and viscosity in the finishing treatment. The following oils are typical lubricating oils, and other varieties are but variants from these.

Ice machine oil and neutral oil are usually made by reducing the distillate from the first reduction of lubricating stock. An ice machine oil which is 23 degrees when finished will be reduced to say 21½ degrees, a neutral finished at 22 degrees will be reduced to 21 degrees.

Red oils (engine oils) and automobile cylinder oils are made from reduced lubricating stock. A red oil to be finished at 19 degrees will be reduced to 16 degrees, an auto oil to be finished at 20 degrees will be reduced to say 16 degrees. All the above oils are finished by an acid treatment and washing.

Cylinder oils are made from straight reduced stock either by acid treatment or by filtration. Filtration consists in passing the hot reduced stock through layers of freshly ignited bone charcoal. The coal takes out the impurities and the coloring matters—the first drops coming through the filter will be very pale, this color becoming darker and darker until finally the bone coal is exhausted, and the oil passes through unchanged. This method of finishing gives a pure and clean oil, but is difficult to apply to California oils. Filtration, in improving the color, greatly reduces the viscosity and the lubricating power.

In finishing by acid treatment, the reduced stock is pumped into steel tanks with conical bottoms, called agitators. These are provided with open end air pipes reaching to the bottom of the cone, by means of which the contents are agitated. Into the oil is poured a small amount of commercial sulfuric acid and the mixture agitated for some time. The acid becomes thick and black, absorbing several times its bulk from the oil, and in this state is known as acid tar or sludge. The sludge is allowed to settle out, and finally drawn off at the bottom, and burned or thrown away. This treatment with acid is repeated until the oil comes to the proper color, a point requiring some skill to determine, as the acid oil has not the color of a finished oil, but is a greenish-blue, sky-blue or even purple color when seen from above, and a dark red color in drops.

After all the acid possible has settled out and been drawn off, the alkali, a solution of caustic soda in water, is added and thoroughly mixed. The oil turns very sharply to a pale cloudy color, or even to a milk white. Great care is exercised at this point to get the mixture exactly neutral, as if it is left acid the oil will darken, while if it is made alkaline the excess of alkali is very difficult to wash out.

When neutralized, the oil is washed with warm water, either by adding water in small doses, mixing, settling and drawing off, or by spraying water over the top, and drawing it off as it accumulates at the bottom. The first water which comes through is milk white, and washing is continued until the water comes through perfectly clear. The oil then has its finished color, but is cloudy.

The last step is clearing out the cloud, which is done by keeping the oil warm in flat pans, and blowing air through it by perforated pipes. This air takes out the water cloud, and leaves the oil perfectly clear and bright, when it is ready for the market.

Acid treatment is essentially the same for all kinds of oil. Light oils lose about ten per cent of their volume to the acid, and one or two per cent to the alkali and water. Engine oils lose up to twenty-five or thirty per cent of their volume in treatment. This loss and the handling are the principal sources of expense, as the chemicals are not very expensive, but in the making of such oils as auto oil, which loses up to 40 per cent, the expense is considerable.

The color of the finished oil may be anything which the price will justify. The more acid used, the greater the loss and difficulty in handling, and the paler the color. The color, as has been often repeated, is of no importance whatever for most uses, but the market demands certain shades, and often pays heavily for them.

The principal difference between California lubricating oils and those of Pennsylvania is in weight—viscosities being equal our oils will be several degrees Beaume heavier than the Eastern oil. The flash point of our oils is also lower for the same gravity—these differences are due to basic differences in the raw materials, and cannot be much affected by refining methods. The reputation of California lubricating oils has also suffered from the difficulty of washing them entirely clean, which has led to a good deal of oil being put on the market with traces of soapy alkali products in it. These do not harm the lubricating properties, but cause the oil to emulsify and froth when rubbed up with water, and sometimes cause it to turn cloudy on standing. In the case of cylinder oils this is a very bad feature, and the production of a satisfactory cylinder oil from local stock has only been accomplished within the last two or three years. So far as other oils are concerned, while they have not the beautiful green color of the best eastern goods, they are in use fully equal to the best, and with the shrinkage in eastern supply, and the growth of our own fields, California lubricating oils have about absorbed the local market, and are rapidly becoming standard in the east.

SOME NOTES ON THE HISTORY OF PETROLEUM.

BY GORDON SURR.

Of the many interested in oil few give a thought to the history of the petroleum industry, yet natural hydrocarbons have been known and used from time immemorial. Gordon Surr, in the Mining World, recently abstracted the following notes, drawing freely upon W. S. Tower's "The Story of Oil."

The words rendered "pitch" in the Bible apparently refer to mineral pitch or bitumen, and we are given to understand that Noah coated his ark "within and without with pitch." In building the Tower of Babel, it is said "slime had they for mortar," but in some versions the words are translated "bitumen" in place of "slime," which throws light on the statement that "the vale of Siddim was full of slime pits."

Pieces of brick are found with a kind of asphalt mortar attached to them among the ruins of ancient Assyrian cities, while walls cemented with bitumen may still be seen in the ruins of the tower of Ackerouf, in old Chaldea, which was built at least 3500 years ago. Ancient bitumen and naphtha wells are said to have been discovered in many Assyrian localities, and bitumen is found to have been largely used as cement in building Babylon and Nineveh. The Egyptians used bitumens in embalming, probably 4000 years ago, for in many mummies the cavities are filled with asphaltic material, and petroleum is said to have been employed in the manufacture of the Egyptian papyrus.

The first account of the apparently more or less regular collection of petroleum was, however, written about 450 B. C. by the Greek historian, Herodotus, who says, "At Ardericca is a well that produces three different substances, for asphalt, salt, and oil are drawn up from it in the following manner. It is pumped up by means of a swipe and, instead of a bucket, half a wine skin is attached to it. Having dipped down with the swipe, a man draws it up, and pours the contents into a reservoir, and being poured from this into another it assumes these different forms; the asphalt and the salt immediately become solid, but the oil they collect; it is black, and emits a strong odor." Ardericca was in ancient Persia.

The Roman records are of particular interest owing to the references to wells in Sicily, from whence oil was obtained which was burned in lamps in the temple of Jupiter about the beginning of the Christian era. This is the first recorded instance of the use of petroleum for lighting, and Italian petroleum has been more or less used ever since as a source of light.

The inhabitants of the Hanover district in Germany are said to have used petroleum for ages, both for lighting and lubricating. They obtained their supplies from deep pits, called "grease holes," by dipping bundles of long reeds into the water, the adhering oil being removed by twisting the reeds together and thus wringing them out.

Although the petroleum wells in British Burma are considered by some as possibly the oldest in the world, the Baku district in Russia is far and away of chief interest in the ancient history of petroleum. Burning jets of natural gas are supposed to have existed for unknown ages in this region, and probably gave rise to the worship of fire. As Mr. Tower well says, "here in sight of the eternal flames, flickering above crannies in the rocks, lighted no one knows how, man, subdued with awe, came first to worship the mystery of fire. Here, for countless generations, hordes of Parsee worshippers came from Persia and far away India, from across the Caspian and the river Oxus, on pilgrimages to Baku, the holy city of fire, to their ancient stone temples and shrines, dedicated to the hidden power of flames that never ceased. Even until a generation ago, the famous temple of Surakhany welcomed its devotees from India, who still came to worship at the altars where the fires burned unquenched after thousands of years. Today pipes have been fitted to the crannies in the rocks; the gas is used by enterprising natives to warm their huts or cook their food, and profane oil derricks dot the surface. But in spite of all the dirt and ugliness in a modern oil region, the romance of history still hovers over the place where man perhaps first learned the nature of fire and bowed himself down in its worship."

The burning gas springs and fire worshippers are referred to in the early stories of Baku, but the use of petroleum itself is first directly mentioned by Marco Polo, who, visiting the region in the latter part of the 13th century, reported a great fountain of oil from which "a hundred shiploads might be taken at one time." He further remarks that the oil was good to burn, but not to eat, and was also used to cure diseased camels. Polo, though at times inclined to exaggerate, certainly spoke the truth when he stated that the oil was not good to eat, and, in later accounts, Baku is described as the source of oil which is "burned throughout all Persia." From springs in the Baku district, the Persians seem to have obtained oil in great abundance, which was used by all classes for fuel and light, and was, moreover, carried in bulk in sailing craft. Had the worthy Marco Polo been living a few years ago he could assuredly have seen another great fountain of oil for, in 1898, a single well in the Baku region yielded 3,500,000 bbls. of petroleum in 30 days, which means about 117,000 bbls. daily.

In short, bitumens and petroleum have been long employed for various purposes in many countries of the Old World and there is no doubt that petroleum was used medicinally by the American Indians before the coming of the French or English. The first mention on record of American petroleum, however, appears in a letter of a French missionary who, in 1627, saw a fountain of bitumen near Lake Ontario, and a "fountain of bitumen" is marked on a map, dating from 1650, in the vicinity of the present village of Cuba in New York State. During the latter part of the 18th century petroleum was used to some extent as a medicine by the whites, under the name of "Seneca Oil," but of so little account was it considered that, even in the earlier part of the 19th century, it was looked upon as a nuisance by the salt makers who cursed the oil that ruined their brine. These salt makers formerly dug wells from whence they obtained their brine, but later drilling tools were employed, and the first real drilled well west of the Alleghanies and possibly in the country, was bored about 100 years ago in the Kanawha valley, West Virginia. After this it became the general practice, in sinking these wells, to dig down to the bedrock and then to drill.

In 1826, a certain Dr. Hildreth published an article in which he prophetically stated, regarding petroleum, that "this product offers great resources as an illuminating agent, and will certainly become of great utility in lighting the future villages of Ohio," and, a few years later petroleum was used, where abundant, for lighting and lubricating, in place of sperm oil.

Some years before, Samuel Kier, a Pittsburg druggist, put up crude petroleum in small bottles bearing the following legend:

"Kier's Petroleum or Rock Oil, Celebrated for its wonderful curing power. A Natural Medicine Pumped from a well in Allegheny County, Pennsylvania, 400 feet below the surface of the ground."

Although by extensive and ingenious advertising, the sales were raised to as much as three barrels a day, the demand began to fall off and Kier found himself overstocked, whereupon he began to sell his medicine as lamp oil, but naturally the crude oil, with its abominable smell and smoke, was not much of a success as a household illuminant.

While Kier was trying to dispose of his oil as a cure-all, plants were being erected in various places for distilling illuminating oils from coal and shale, an industry which started in France about 1832. In 1846 Abraham Gesner, the famous engineer, made an illuminating oil from coal and introduced it into the United States, from Prince Edward Island, under the trade name of "Kerosene," and a few years later several plants in the United States were manufacturing these "coal oils." Possibly the success of these oils as illuminants suggested possibilities to Kier, but, at any rate, he tried refining crude petroleum about 1852, and after various experiments finally produced a distilled illuminating oil, which, though far from perfect, was a great improvement over crude petroleum. Oil, distilled from crude petroleum, is said to have been first used for lighting in Prague, Bohemia, in 1810, although Kier's was the first illuminating oil distilled from American petroleum, and Pittsburg the first place to use it. The first barrel of this refined oil was sold in New York at 70 cents a gallon, and at times prices reached $2 a gallon.

The consumption of Kier's "Carbon Oil" soon taxed the old salt wells to their utmost capacities, for not a single well had as yet been put down expressly for oil. In 1854, Jonathan Eveleth and George H. Bissell, New York lawyers, organized the first oil company in the United States, under the name of the Pennsylvania Rock Oil Company, "to raise, procure, manufacture and sell rock oil." The property of the company consisted of some 100 acres on "Watson's Flats," bordering Oil Creek, Pennsylvania. The company was later reorganized but it was soon plain that, to make a profit, larger quantities of oil would have to be obtained than what could be procured by skimming the water in pits and streams. Strangely enough, the suggestion for a solution of the problem was offered, it is said, by one of Kier's old cure-all circulars, which pictured the artesian well from whence he claimed to have secured his oil. Finally the company decided to drill a well on the Oil Creek property, and the work was put in charge of Elwin L. Drake, then a railroad conductor. Drake left for Oil Creek in 1858, and at the time of his departure his employers are said to have dignified him with the title of "Colonel," for business reasons, by which title he was thereafter known.

The plan was to dig down to the bed rock and then to drill but, in spite of every effort, the sand continually caved in and filled up the pit. At length, in 1859, Drake hit upon the ingenious device of driving an iron pipe down to the solid rock, and working the drilling tools through the pipe. At this time he succeeded in getting William Smith and his sons as drillman and helpers, who were men of long experience in sinking salt wells, including those from which Kier is said to have obtained his oil. After repeated attempts, the pipe was finally forced through the sand and loose material, when drilling was commenced with no more trouble from caving. Two or three feet a day was the best they could do in drilling, and having gone down about 69 ft. the men, returning to work on the morning of August 26, 1859, found the well nearly full of oil. Thus "Colonel" Drake and "Uncle Billy" Smith brought into being the first well ever drilled for oil in the United States, little dreaming of the present gigantic industry which has grown from this humble beginning. Truly it is not the part of wisdom to despise "the day of small things."

AMERICAN SOCIETY OF ENGINEER DRAFTSMEN.

On June 18th the first steps were taken to form a permanent organization to be known as the American Society of Engineer Draftsmen, embracing every branch of the profession, including mechanical, electrical, civil architectural, marine, sanitary, automobile and aeronautical draftsmen. The first meeting of the Society was held on July 27th. The formation of this organization, which was conceived by E. Farrington Chandler, a well known designer and inventor, marks the first effort to form a national society among draftsmen.

Draftsmen have long felt the need of an organization, both from an engineering and a fraternal standpoint, which would be the means to establish a higher professional standing and place them on a recognized professional plane, in the field of engineering.

The benefits of an organization of this character are well understood and need no elaboration. A decided feature of the Society is the opportunity offered Juniors, affording means by which they may become familiar with the demands of practice, in the drafting room, while students or employees in other branches of industrial work, as is also an employment bureau cooperating with employers.

The qualifications for membership are such, that a standard will be established, as in other branches of engineering, and it is the aim of the Society to maintain this standard, and to secure recognition from every concern employing draftsmen.

The officers chosen, are E. Farrington Chandler, president; Wm. B. Harsel, vice-president, and Henry L. Sloan, secretary and treasurer, with headquarters at 116 Nassau Street, New York.

ALEXANDER HENDERSON.

On Thursday, August 11, 1910, Alexander Henderson died at "The Anchorage," his home in the hills of New Hampshire, after an illness of several months; he was buried on Monday of this week.

"Alec" Henderson, as he was fondly known by thousands of friends in the electrical fraternity to whom he had endeared himself by his lovable nature, was prominently identified with the electrical trade for over a score of years, since 1906 having been associated with the American Circular Loom Company of Boston, Mass., remaining with them until the time of his death.

During some thirty-five years of business life, he traveled throughout the length and breadth of the land, always ably representing his employers and also drawing to himself the friendship of every man with whom he came in contact, until it became proverbial that all of his acquaintances where his friends.

Alexander Henderson

Of his many visits to the Pacific Coast perhaps the most memorable was that in January, 1908, when, as the guest of the electrical jobbers at Del Monte, he told of the hopes and aspirations to which he had steadfastly clung throughout the many buffetings of business life. His fondest dream, that during his declining years he might have a home "whose latch-string would not be hanging on the outside, because there would be no latch-string, but always a warm welcome to his friends," was finally realized when he bought a beautiful spot in the hills of New Hampshire and erected a modest cabin, which he called "The Anchorage" in memory of the feeling of perfect peace and contentment, which this term symbolizes to those that brave the seas, such an experience being an episode of his own boyhood life.

Mere words cannot do justice to the memory of this man, which has been perpetuated by the good deeds he accomplished. Of him it might truly be said that the world is better because he lived; in this respect he achieved the fullest measure of success.

His death is a personal loss to every member of the electrical fraternity. This is feelingly exemplified in the following letter from one of his dearest friends.

THE EDITOR:

"Friday last we were advised that our mutual friend, Alec Henderson, has gone across the Great Divide. Alec was one of my best friends. He no doubt, had the most extensive acquaintance of any man in the electrical business, a man beloved and respected by all. He had the peculiar quality of making fast friends on short acquaintance; this was because of his sterling qualities. Liberal to the limits of his purse, honest without regard to personal interest, always courteous and a man above men. Alec was a prince and all who knew him loved him.

"About a year ago, he wrote me in a vein unusual to him. It is difficult to say what prompted him; a man usually reticent about his own feelings, he gave expression to sentiments that showed the character of the man. I am taking the liberty of quoting one or two passages from the letter:

"*It cannot be more than a few years until some of your older friends cross the Divide and when my time comes to go, I sincerely hope that there will be but one feeling among my friends, that of great rejoicing that the struggle is over and that at last I am free to explore new conditions of which we know so little.*"

That he esteemed his friends on the Coast is evidenced by the expressions in that letter:

"*I don't know how else to make you understand the great depth of appreciation in which I hold your friendship and the friendship of the 'boys' that stretch up and down and across the continent; yes and even beyond on both seas and that have helped me so much during all the years and that will give me strength and courage and endurance to the end.*"

The expression of affection which Alec gives utterance to, quoted above, is of such a character that all his friends should know of it. I, therefore, appreciate the opportunity to express, through the Journal, these lines in Alec's behalf.

Yours very truly,

T. E. BIBBINS.

DISCUSSION ON STEAM ENGINEERING PRACTICE.[1]

Rating Boilers on Thermal Efficiency.

W. P. Millner: How about rating boilers and engines on their thermal efficiency?

R. F. Chevalier: Rating by thermal efficiency is the correct method. A boiler rated at 100 h.p. is capable of developing 50 to 150 per cent more without injury. Builders rate boilers by square feet of heating surface. The capacity of a boiler depends upon the quantity of fuel capable of being burned beneath it. Where coal is used, grate area is an object. By increasing this grate area and with proper combustion boiler capacity is increased. There are several instances where fuel is burned from both ends of a boiler thereby doubling the capacity. The volume of the gases of combustion is considerably less with oil fuel than with coal. The temperature drop over the heating surface is greater due to rapid and complete combustion. The area of gas passages throughout the boiler may be decreased to great advantage and also a longer travel given to the gases. These conditions are favorable to higher efficiencies and greater capacity. More draft is required at the damper which increases the velocity at which the gases travel over the heating surface. A Babcock and Wilcox boiler fourteen tubes high and rated at 680 h.p., with superheater, showed an average temperature of 900 degrees F. at the top of the first pass. The gases traveling through the superheater dropped 150 degrees F., so that when entering the second pass over the boiler tubes the temperature was 750 degrees F. The temperature of the escaping gases at the damper were 550 degrees F. The furnace temperature was 2600 degrees F. About 37 per cent of the total heating surface of this boiler is in the first pass, where 83 per cent of the drop in temperature occurred. The superheater reduced the temperature of the gases 7 per cent and the remaining 63 per cent of heating surface reduced them another 10 per cent.

Baffling Boilers.

R. F. Chevalier: The question of baffling boilers has been given considerable thought where coal is used as fuel. Builders seem to persist in thinking that the same conditions should prevail where oil is used as fuel, at least very few attempts have been made to alter the arrangement of the baffles. Reducing the draft by adding baffles to decrease the cross sectional area of a pass where the gases turn usually results in greater efficiency. The same effect is obtained by partially closing the stack damper. In following this method the velocity of the gases is retarded and tend to increase the amount of inert gas surrounding the heating surface. Better results would be obtained by increasing the number of passes thereby decreasing the area of each and increasing the velocity of the gases over the heating surface and reducing the layer of inert gases.

Question: Would you narrow the first pass in proportion to the second?

R. F. Chevalier: Reducing the passes would depend upon existing conditions. With a draft at the damper of 0.25 in. of water, and .1 in. or less in the furnace it would not be advisable to change the baffles, as that would tend to reduce the capacity of the boiler. But if the draft at the damper and that in the furnace is high the best results would be obtained by a change in baffles. Moving baffles in a boiler that is already bricked in is expensive, the gain effected by such would have to be considerable to warrant the expense. A thorough investigation of conditions would be necessary before determining the area and number of passes that would be best suited.

L. W. Holbrook: Do gases contract or expand more as they go out?

R. F. Chevalier: As the gases move over the heating surface their temperature decrease and the volume is reduced accordingly.

J. G. De Remer: Does the velocity increase?

R. F. Chevalier: As the volume decreases, the velocity increases. This increase in velocity is also due to an increase of draft and a lessening of resistance to the flow of gas.

[1]California No. 3, N. A. S. E., July 20, 1910.

THE FACTORS OF INDUSTRY.

That capital and labor are the prime factors in the production of wealth was always a mistaken belief and is now an outworn doctrine, we are told by an editorial writer in Engineering (London, July 8). He admits both as factors, but ranks labor second and capital third. First of all he places enterprise, aided by experience and knowledge.

There is plenty of capital in the city, and plenty of labor walking the streets, yet they do not produce wealth. Enterprise, aided by experience and knowledge in the form of management, is required to utilize these forces—i.e., capital and labor. Labor is the second factor in production, and capital the third factor. It is essential, however, that management and labor should be highly skilled, for otherwise neither can profitably assist capital. . . . .

We have indicated that enterprise, experience and knowledge are the principal factors in wealth production. This applies to the manager in management, and to the workman at his machine. Modern economics demand this differentiation. Enterprise, knowledge and concentration are wealth productive, and especially so if confined within the sphere of activity in which experience has been gained. In other words, specialization is the key to profitable production. If these forces are to be utilized for the common good, they will require some form of organization, and a good organization requires good management. If these forces are not organized and managed, unemployment will be prevalent in labor and in the higher spheres of life. We perforce see that one of the greatest factors in production is management, and as the evolutionary process advances we recognize this more and more.

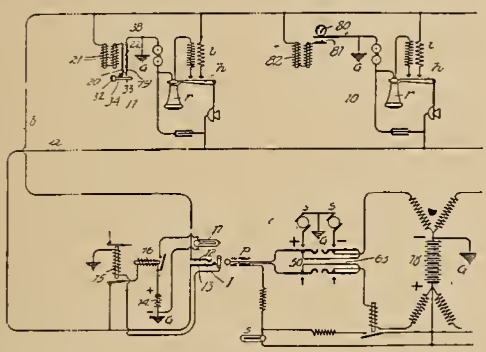
The large producer has many advantages which the smaller has not; he can afford to install new machinery built specially for cheapening production as it appears on the market. As already stated, what is new to-day is old to-morrow, and nowhere is this more true than in engineering. Cheap production is a boon to humanity, for it tends to bring luxury within the reach of all; cheap production in one sphere of activity stimulates further production in other spheres of activity, as it makes possible what in other circumstances might be impossible. As an illustration, let us take the case of a sewing machine. This is a necessity in most homes, more especially in poor ones. If the cost of producing these machines were high, only the better-class families could afford to buy them; but if the cost of production be low, every family may buy them; and so we come to see that one of the essential factors in human welfare is cheap production. It should be our main object in life, therefore, to bring about a general recognition of this principle; to see that the economic aspect of it is thoroughly understood by the workman himself. But it should be borne in mind that cheap production will not be brought about by cheap labor or by forcing labor to do more than it is physically capable of doing. Labor should have an adequate return for the services which it performs in production, and labor should not expect more.

We know that all men are not equal in ability, and can not be made so, but it is desirable that all men shall have equal opportunities. In the countries in which this principle finds the widest acceptance economic progress is the greatest. The enormous business activity in the United States of America is in a large measure due to this. One of the advantages of the free play of individuality is that by it the creative class of man—the man with ideas—is brought to the front. Men are divided into three classes—viz.: 1. The creative, the men of genius, the originators. 2. Those who manage for the first—the administrators. 3. Those who do the labor appointed by the first and second—the artizans.

Men of the first class will always be the real governors of the state. They are born not made, but economic conditions should be fostered that will favor their free development.

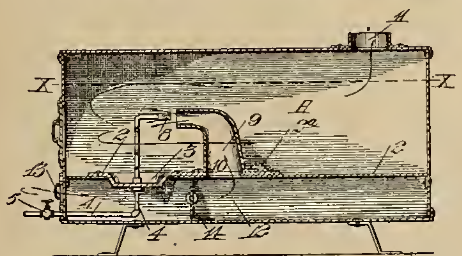
PATENTS

966,809. **Electric Service-Meter.** Oliver C. Dennis, Chicago, Ill., assignor, by mesne assignments, to Western Electric Company, Chicago, Ill. In a telephone metering system, a telephone line, talking apparatus associated with the line,



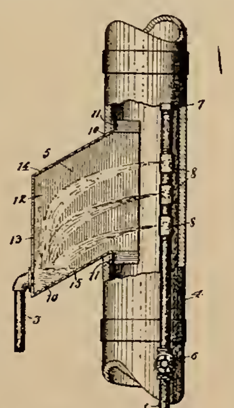
a register connected to the line, manual means for operating the register, and an electrical circuit independent of the talking apparatus for disconnecting the manual operating means of the register.

966,899. **Oil-Burner.** August J. Garloff, Stony Point, Cal. An oil burner comprising a base plate having a depressed pan, an oil conducting tube extending through the pan to a point above the same, and having the extended portion



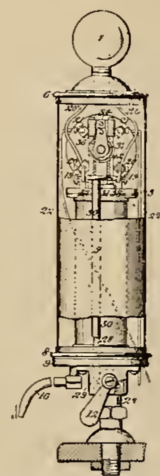
bent transversely to form a vertical series of coils, the terminal of the upper coil being bent horizontally in a plane at right angles to the coils, and having a burner fixed to its end, and an air-conduit extending upwardly from the base and having its discharge end separated from and presented horizontally toward the burner.

967,135. **Smoke-Cleaner.** Joseph Lachance, Morgan Hill, Cal. A smoke conduit in combination with a plurality of horizontally disposed parallel pipes extending through said



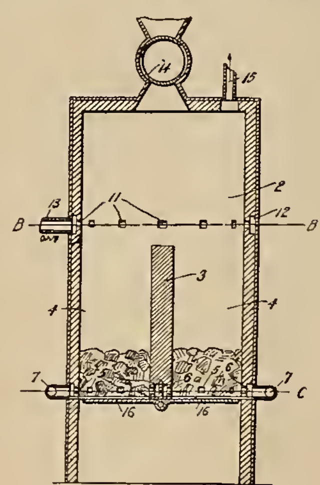
conduit one above the other and each provided with a longitudinally disposed slot extending substantially the width of the conduit and upon the same side of the pipes, said pipes being arranged at one side of said conduit, the side of said conduit opposite said pipes being provided with an aperture, a box fitting said aperture and having a closed bottom extending outwardly and downwardly therefrom, said aperture and said box being of greater height than the distance between the upper and lower pipes, and a drain pipe extending from the lower portion of said box.

967,058. **Electric Water-Heater.** Herbert N. Roche, San Francisco, Cal., assignor to Thomas B. Gray, San Francisco, Cal. In a water heater, the combination of a receiver, inlet and discharge connections thereto, an electric heating unit in



said receiver, a rotatable snap-switch, and means including a longitudinally movable member associated with the inlet connection, and a member engaged and rotated thereby and connectible to the switch.

966,718. **Gas-Producer.** Walter Thomas, Vancouver, British Columbia, Canada. In a device of the class described a casing, a grate within said casing dividing it into an upper and a lower portion, a partition in said upper portion dividing said upper portion into a pair of generating chambers,



said casing and said partition each having surrounding passages and twyers effecting communication between said passages and the interior of said generating chambers, valve controlled means for admitting air into said passages, valved controlled means for conducting gases from said passages, said passages for each of the generating chambers being separate and distinct, and means for admitting fuel through the top of said casing.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

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C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS
Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Preventing Accidents

The manifold savers of time and of labor that have been provided by our modern civilization are unfortunately not proving to be savers of life. Whereas the accidents that threatened primitive man could be counted on the fingers of his hands, we are now encompassed by dangers whose numbers exceed the hairs on our head. The advantage of the time economy effected by the electric railway is largely nullified by the growing list of trolley victims. Every branch of manufacturing, from the winning of the fuel and raw material to the marketing of the finished product, is accompanied by its life hazard. Exploding boilers, bursting flywheels, unguarded gears and unprotected electrical apparatus add their daily toll of death. No wonder the small boy differentiated "the quick and the dead" as those who do and those who do not get out of the way of the automobile.

The social responsibility of parent for child is far less binding than is the obligation of science for these agents which it has created. More than half the accidents to which we are heir are due to preventable causes, the remainder being inherent in the inevitable risks of certain employments. Statistics show that about half of the avoidable accidents are due to the worker's carelessness or lack of skill, the other half being caused directly or indirectly by the employer's negligence, especially in providing proper safety appliances. The inventor has already shifted a portion of his responsibility by furnishing devices which obviate many dangers and is now busily engaged in providing additional ones. Consequently it remains for employers to adopt these safeguards either through enforced legislation or from self-interest.

The last factor has already proven to be a powerful incentive, insomuch as it is cheaper to install safety appliances than to fight law suits and pay damage claims. Wider recognition of the employers' liability cannot but lessen industrial casualities.

The efforts of individuals to minimize accidents are now being supplemented by concerted action on the part of several organizations, particularly noteworthy being the newly established Bureau of Mines, the Museum of Safety and Sanitation established in New York City last year, and the National Association of Manufacturers, who have sent a committee abroad to study prevention and industrial relief methods in Europe. The result of their researches should be of great aid in lessening accidents.

But the fact still remains that the employee has a like responsibility. Many workers for whose benefit all these precautions are taken often oppose their introduction. A strike was recently called in one of the Pennsylvania coal mines because a helper was discharged for attempting to carry matches into a mine showing signs of gas accumulation. Many a boiler explosion has been traced to the engineers' carelessness in allowing scale to accumulate, just as bursting flywheels are frequently due to a blocked engine governor. Familiarity with danger often brings corresponding contempt among experienced workers who fail to exercise the ordinary precaution of the novice. It is impossible to make all machinery absolutely foolproof, and so Nature must continue to exercise her inexorable law of the survival of the fittest.

PERSONALS.

A. M. Hunt has returned to San Francisco after a business trip to Portland, Oregon.

F. F. Skeel, of Crouse, Hinds & Co., is in the Northwest, whence he will return East.

E. C. Johnson has been appointed chief engineer of the Los Angeles-Pacific Company, Los Angeles.

K. G. Dunn, electrical engineer with Hunt, Mirk & Co., has returned to San Francisco from an Idaho trip.

H. R. Noack, of Pierson, Roeding & Co., San Francisco, made a trip through Nevada during the past week.

H. A. Foster has opened an office as consulting electrical engineer at 521 San Fernando Building, Los Angeles.

F. T. Mumma, formerly with the Great Western Power Company, recently joined the engineering staff of Hunt, Mirk & Co.

B. C. Carroll, general agent of the Pacific Telephone & Telegraph Company, is making a tour of Northern California.

John Coffee Hays, general manager of the Mount Whitney Power Company of Visalia, arrived at San Francisco last Monday.

H. C. Keyes, secretary of the Sacramento Natural Gas Company, of Sacramento, Cal., was a San Francisco visitor last week.

R. S. Chapman, an electrical engineer with H. M. Byllesby & Co., of Chicago, is in San Francisco from the Pacific Northwest.

Guy C. Earl, chief counsel of the Great Western Power Company, has returned to San Francisco after a tour of four months through Europe.

H. V. Carter, president of the Pacific States Electric Co., returned to San Francisco from Los Angeles this week, being accompanied by his family.

J. B. Struble, one of the engineers of the Union Switch & Signal Company, which furnishes equipment for both electric and steam roads, arrived at San Francisco last week.

J. D. Ross, electrical engineer for the Seattle Municipal Light & Power Plant, has been transferred to the grade of Member in the American Institute of Electrical Engineers.

E. V. Eardley, formerly with the General Electric Company at Boston, has resigned to take a position as electrical engineer with the Knight Power Company, Salt Lake City, Utah.

Paul Shoup, assistant general manager of the Southern Pacific electric lines, spent the past week at Portland, Ore., in conference with R. S. Lovett, the president of the company.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, of Milwaukee, recently paid a visit to the company's San Francisco office after making a tour of the Northwest.

L. H. Baldwin, assistant manager of the Kellogg Switchboard & Supply Company's San Francisco office, is making an extensive business trip through Northern California and Southern Oregon.

John Harisberger, superintendent and electrical engineer of the Seattle-Tacoma Power Company, has been transferred to the grade of Member in the American Institute of Electrical Engineers.

R. W. Sorensen, formerly with the transformer engineering department of the General Electric Company, Pittsfield, is now associate professor of electrical engineering at Throop Polytechnic Institute, Pasadena, Cal.

Henry S. Carhart, formerly professor of physics at the University of Michigan, and now retired under the provisions of the Carnegie foundation, has returned to Ann Arbor after spending six months at Pasadena, Cal.

Wynn Meredith, Pacific Coast manager of Sanderson & Porter, of New York, will return to British Columbia on engineering business next Tuesday after spending two weeks at his San Francisco office.

Alfred E. Braddell has been transferred from the Chicago office of the Sprague Electric Company to the company's general offices in New York City where he will devote his time to special work in the conduit supply and sales department.

C. E. Maynard, auditor, and J. H. Hornung, commercial agent, for the Great Western Power Company, have returned from a trip through Southern California. They visited the Southern California Edison Company's hydro-electric plant in the Kern River Canyon, near Bakersfield, and the steam power plants of Los Angeles.

W. R. Alberger has been elected a director and a vice-president of the Oakland Traction Company, and will be the active head of the electric system at Oakland, Cal. Mr. Alberger will continue to perform his duties as traffic manager of the Tonopah & Tidewater Railroad, which is another of F. M. Smith's enterprises.

J. F. Adams has resigned as district commercial manager of the Pacific Telephone and Telegraph Company with offices in Reno, Nev., to become general manager of the Nevada-California-Oregon Telephone and Telegraph Company. The company has already constructed 145 miles of line and has offices at Reno, Plumas Junction, Amadee, Hot Springs and Doyle.

George B. Ellis, president of the Union Home Telephone Company, with headquarters at Los Angeles, has been spending a few days at San Francisco. His growing company has twelve exchanges in Southern California cities, including Riverside, San Bernardino and Long Beach, and interchanges business with the Home Telephone Company, of Los Angeles.

Newly elected Associates in the American Institute of Electrical Engineers include F. W. Brown, draughtsman, Pacific Gas & Electric Company, San Francisco; W. M. Fagan, purchasing agent, Pacific States Electric Company, 107 Security building, Los Angeles; O. M. Fisher, electrical engineer, Spokane; H. J. Flager, engineer, Eastern Montana Electric Railway, Red Lodge, Mont.; C. F. Forshund, power house foreman, Sierra & San Francisco Power Company, Vallecito, Cal.; C. K. Goodwin, electrical superintendent, West Side Lumber Company, Tuolumne, Cal.; L. J. Kraps, repair electrician, Sierra & San Francisco Power Company, Vallecito, Cal.; F. S. Lorentz, electrical engineer, construction department, Keating Gold Mining Company, Radersburg, Mont.; W. C. Miller, Jr., engineer of power stations, Southern Pacific Company, San Francisco; T. W. O'Reilly, Los Angeles; C. N. Rakestraw, assistant engineer Telluride Power Company, Provo, Utah; T. J. Royer, steam electric operator, Los Angeles Aqueduct, Aqueduct, Cal.; S. P. Skoog, electrician, California Wine Association, San Francisco; W. M. Stahl, plant department, Rocky Mountain Bell Telephone Company, Salt Lake City; E. F. Whitney, sales agent, General Electric Company, Seattle; C. A. Wolfrum, superintendent, Telluride Power Company, Grace, Idaho; C. Wortman, engineer, Home Telephone Company, San Francisco.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION.

As herebefore mentioned, the annual convention of the Northwest Electric Light and Power Association will be held this year on the steamer Queen leaving Seattle the evening of August 26th and returning the morning of August 29th. Arrangements have been perfected for a number of excellent papers and all signs point to a most successful meeting. Arthur Gunn of Wenatchee, Wash., is president, and Norwood W. Brockett, Cataract Building, Seattle, Wash., secretary.

INDUSTRIAL

SELF-PROPELLED MACHINE SHOP.

The North Coast "Short Line" Railroad, of which Mr. Robert E. Strahorn is president, is still forcing its way through central and western Washington, from Spokane west to the rocky slope of the Cascades. The North Coast passes through the most fertile, irrigated valleys in the State, and will cross the Snake and Columbia rivers, the latter in two

North Coast Machine Car.

different places; the bridge at Burbank across the Columbia, costing $1,000,000. This line is the Walla Walla extension which will probably build east through the Blue Mountains and make connections with some eastern line.

The line now building from North Yakima to a point on the Columbia, in Walla Walla county, making connections

Interior of Machine Car.

with the O. R. & N., will be completed and in operation early this year for the fall trade.

The North Coast equipment is all new, and of the very best and latest designs, including two gasoline motor passenger cars, to handle the local business. The advance in mechanical appliances, which will be used in construction work, has been well planned.

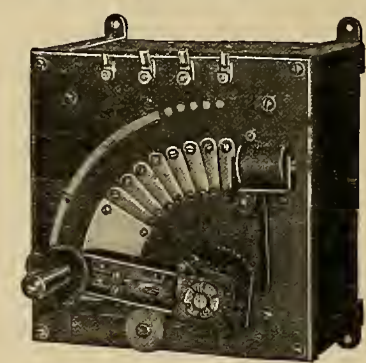
For repairing locomotives and other equipment, until such time as a permanent shop can be erected a machine car is being used. The interior view shows a 12 h.p. Fairbanks-Morse vertical gasoline engine, oil cooled, connected to friction clutch and to the wheels of the car by sprockets and chain, which enables the operator to do switching with the car and also move from one station to another, doing work without assistance of a locomotive, making eight or ten miles an hour. The tools in the car include one 23 in. engine lathe, one 16 in. shaper, one 1½ in. bolt cutter, one 6 in. pipe threading machine, emery wheel, and a 22 in. vertical drill. The dimensions of car inside 39 ft. 10 in. long, 9 ft. 6 in. wide and 9 ft. high.

The gasoline engine when running the shop 12¾ hours consumed 4 gallons of gasoline, with two men working in car on different tools as the work came in. The engine has been running nine months without one cent of repairs.

SPEED CONTROLLERS.

CR-164 speed controlling rheostats are so designed that they combine in a single box both armature and field regulating rheostats, and all speed changes are effected by movements of a single rheostat arm, which is automatically held in any position by a mechanical device. The line includes rheostats designed for machine tool service where full load current is taken at the lower speeds in order that the motors may maintain a constant torque, and also for fan service where the load increases with the speed. They permit of a 50 per cent reduction in speed by armature control and a 25 per cent increase by field control.

For protection from failure of voltage and the consequent danger of power being again thrown on the line without re-



CR-164 Speed-Controlling Rheostat.

sistance in series with the motor armature, they are provided with a no-voltage release attachment. Upon failure of the voltage, the retaining magnet is demagnetized, releasing the arm and a spring instantly returns it to the off position, making it absolutely impossible to close the armature circuit without cutting in all the armature controlling resistance. The no-voltage release coil is connected directly across the line in series with a resistance and is thus independent of the current of the motor field and will protect any motor with which this rheostat may be used.

The contact segments are of liberal size and so designed that they may be very easily and quickly renewed. The resistance units are of an improved design so constructed as to be non-fragile, and thoroughly ventilated.

CR-165 rheostats are the CR-164 rheostats described above with the addition of an overload release coil.

This device is manufactured by the General Electric Company, Schenectady, N. Y.

THE HOLOPHANE CONFERENCE.

The annual conference of the managers and engineers of the Holophane Company was held at Sagamore Island, Lake George, New York, July 10-17, inclusive. This convention is regularly called to discuss improved illumination and incidentally to promote the sale of the Holophane products.

F. H. Poss, the manager of the San Francisco office of the company, who has just returned from the convention, reports that it was a great success. Through his courtesy we are enabled to publish the accompanying illustration of the delegates and invited guests. The latter included Mr. Rockerfeller of the Western Electric Company, as the representative of the Eastern jobbers, William Low of the Electric Appliance Company as representative of the Central jobbers, and Andrew Carrigan of San Francisco as representative of the Western jobbers. Other guests included members of the National Electric Light Association and National Electric Lamp Association.

Members and Guests Attending Holophane Conference.

This year's conference brought up many points of vital interest. Within the past year, the field of industrial lighting has been entered and the need of correct, and scientific reflectors for mill, shop and factory illumination has been proven. While the Holophane Company was the first to enter this field, and while their product is today pre-eminent for industrial lighting, plans are already being laid for advance in this direction.

Residence lighting, also, has become a matter of great importance within the year, especially from the central station standpoint. In this field this company have already been working for many months and within sixty days will announce a new line of artistic reflectors especially designed for residence lighting service.

The Holophane Company's policy has been one of service, which it is the purpose of their annual conference to improve wherever possible.

NEW CATALOGUES.

"Hot Points" for August 1910 from the Pacific Electric Heating Co. tells of the return of the "bill-raisers" and also gives notice of improvements in their electric toaster.

The General Electric Company has recently issued Bulletin No. 4760, illustrating and describing a line of direct current instruments constructed upon the D'Arsonval principle and designed for switchboard use. The bulletin illustrations comprise external and internal views of the instruments, showing the details of construction together with dimension diagrams of the instruments and the shunts, and the scales used for different capacities are also shown.

The General Electric Company has recently issued Bulletin No. 4718, illustrating and describing all of the apparatus required for a complete series incandescent lighting system. The illustrations include Mazda lamps for street lighting with various forms of reflectors and suspension insulators, street system brackets, constant current transformers, panel boards, socket cutouts and ornamental poles, as well as complete dimension and connection diagram and illumination curves.

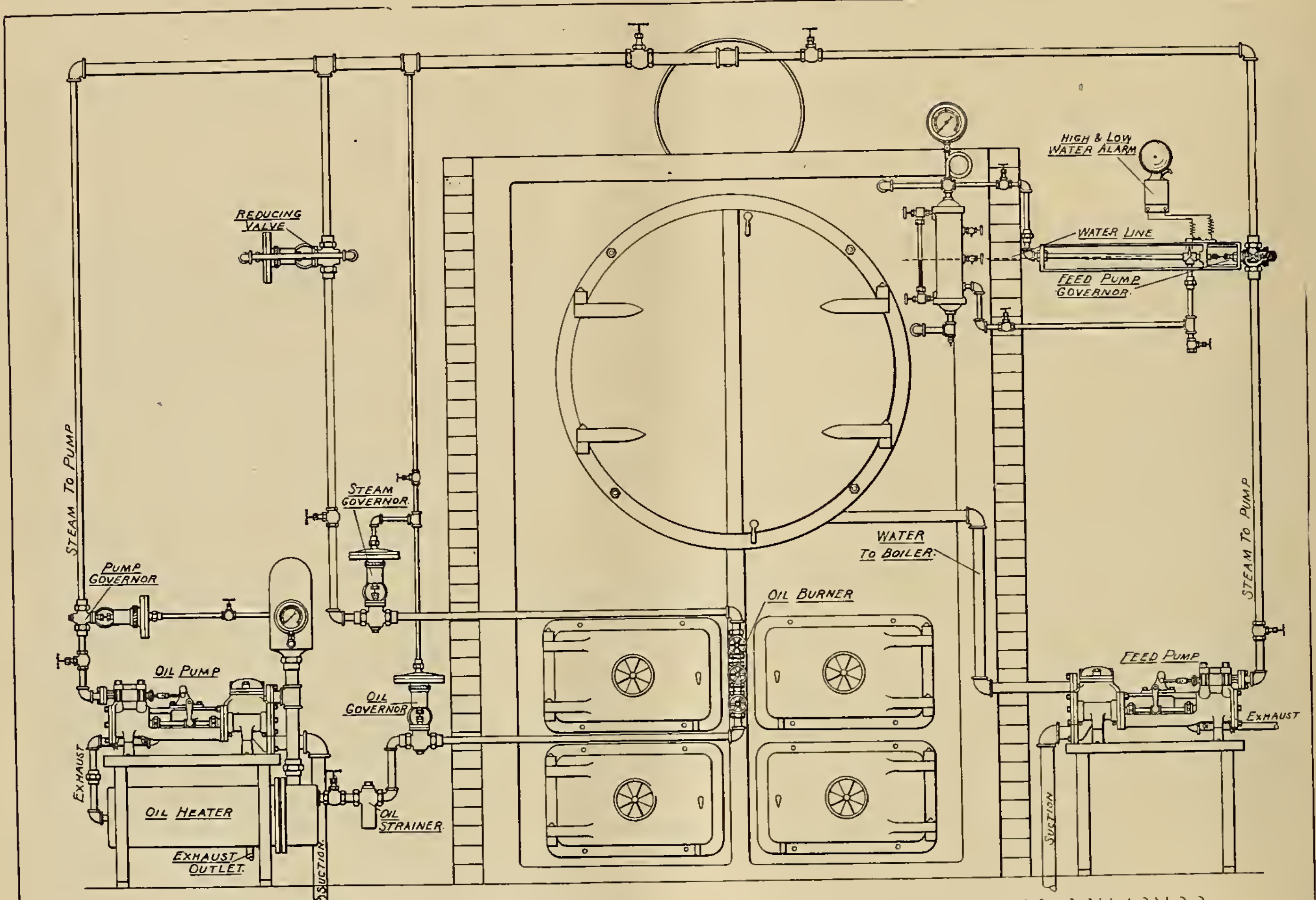
The General Electric Company has recently issued Bulletin No. 4750, describing standard couplings which have been found by experience to fill all requirements, and are adapted for coupling electrical apparatus together, or to other machinery. The types described are the leather link flexible laced belt, rubber buffer and flange coupling. All of these will run equally well in either direction. The bulletin is fully illustrated and contains dimension diagrams of the various types.

Bulletins Nos. 21-27 inclusive, from The Fairmount Electric & Mfg. Co., of Philadelphia, illustrate and describe new electrical specialties manufactured by this company. These include a station pot-heat for lead-covered cables which eliminates the wiped joint and is practically indestructible, "Arclets," a new form of hickey for hanging arc lights or clusters on tubing, "Bendhicks," a short ell bend-proof conduit fitting, "Emery" adjustable and separable tripods for straight electric fixtures, "All-in-one" ground clamps, "Vogel" ground clamps and "Alligator" test connectors.

The General Electric Company has recently issued Bulletin No. 4752, illustrating and describing rectifier sets, luminous arc lamps and all necessary auxiliary apparatus for complete series luminous arc rectifier systems. The bulletin is fully illustrated and shows views of the exterior and the mechanism of the luminous arc lamp, as well as the series vertical carbon flame arc lamp for operation in series with luminous arc lamps. Luminometer chart, illumination curves and wiring diagrams are also shown, together with standard panel boards designed for this class of work. A complete set of dimension diagrams of the various apparatus and a partial list of actual installations are also included.

WITT AUTOMATIC FEED WATER REGULATOR AND OIL BURNER GOVERNORS.

The accompanying illustration and text of the G. E. Witt Company's automatic oil burner governors and boiler feed water regulator, is herewith reprinted from the Journal of July 23, 1910, to correct typographical errors that changed the meaning of vital details. The most essential thing in the operation of a steam boiler is the close regulation of the feed water and constant steam pressure, which is almost impossible to accomplish by hand regulation. The advantages of one governor on the oil pipe leading to the burner. The oil and steam governors are set at the desired boiler pressure, the diaphragm being connected to the drum or main steam pipe of the boiler. As the load increases on the boiler, the steam pressure will decrease, thus causing the governors to open and increase the flow of oil and steam to the burner. Should the load decrease, the boiler pressure will rise, causing the governors to close the flow of oil and steam to the burner. The reducing valve is used in order to get a reduced pressure which is more ecoomical and noiseless.



G.E. WITT CO'S. OIL BURNER GOVERNORS & AUTOMATIC FEED-WATER GOVERNOR.

automatic regulation include a great saving of fuel and labor, increase in capacity of the plant and fewer repairs on the furnace and boiler.

This boiler feed regulator is operated by expansion and contraction. This device is simple in construction, has but one wearing part and is entirely external to the boiler, the expansion member consisting of a brass tube placed in a frame and located on a level with the desired water level in the boiler, one end of the tube being connected to the top of water column and the other end to the lower part of water column. As the water rises in the boiler it also rises in the tube, causing it to contract. This closes the valve and slows down the boiler feed pump which causes the water to recede in the boiler and tube until the steam enters the tube, which causes the same to expand and open the valve to the feed pump. The brass tube in this regulator being placed on a level, it requires but slight movement of the water to operate the valve. This feature insures a close regulation of the water.

The automatic oil burner regulation consists of two governors and one reducing valve, a reducing valve and one governor being placed on the steam pipe to the burner and

TRADE NOTES.

E. H. Hefferman has succeeded J. F. Adams, resigned, as district commercial manager of the Pacific Telephone and Telegraph Company at Reno, Nev.

The General Electric Company is building for the Montreal sub-station of the Canadian Light & Power Company, (J. G. White & Co., Engrs.), a switchboard consisting of a high and low tension switching apparatus. The current will be received at 48,000 volts, stepping down to 13,200. The capacity of the sub-station when put in operation will be 16,000 kw. with a steam auxiliary of 4000 kw. The ultimate capacity is 48,000 kw. with a steam auxiliary of 8000 kw.

The new hydro-electric plant of the Oregon Iron and Steel Company at Oswego, Ore., consisting of a 900-h.p. Pelton-Francis turbine direct connected to a Westinghouse generator, is completed and ready for operation. The plant, which was installed by the Pacific Electric Engineering Company, of Portland, will be used to furnish power for the cement mill now under construction by the steel company. S. G. Gorbett is the engineer in charge of construction of the cement plant.

NEWS NOTES

INCORPORATIONS.

EUGENE, ORE.—The Rogue River Valley Gas Company has been incorporated for $300,000 by J. R. Anderson.

ABERDEEN, WASH.—The E. H. Smith Electric Company has been incorporated fcr $250,000 by Edward H. Smith and Will Lanning.

REDLANDS, CAL.—The Northbrae Water Company has been incorporated by H. P. D. Kingsbury, F. E. Hotchkiss, E. S. Graham, W. P. Burke and E. B. Meeker.

SACRAMENTO, CAL.—The South Sacramento Power Company has been incorporated by H. W. Conger, Fred Ferheart, Robert Lewis, F. L. Holland, A. L. Darrow, J. Goran, George J. Bryle, E. A. Nicolaus, E. L. Southworth and Joseph Shaw.

FINANCIAL.

JACKSONVILLE, ORE.—At the municipal election Jacksonville voted to issue $30,000 in bonds for the establishment of a gravity water system.

VALLEJO, CAL.—The ordinance calling for the raising of $90,000 for water system betterments and $75,000 for a new city hall and branch county jail has been passed by the Trustees.

FALLON, NEV.—The City Council has passed an ordinance authorizing the establishment, building and constructing a water works system for domestic use, manufacturing and fire protection for this city; to borrow the sum of $35,000 for the purpose and to issue and sell bonds of the city.

OGDEN, UTAH.—An election will be held in the City of Ogden, Utah, on September 6, 1910, for the purpose of submitting to vote the question of issuing and selling bonds in the amount of $100,000 for the purpose of constructing an additional conduit from the sources of water supply in the Ogden River system.

EUGENE, ORE.—Eugene's recent $60,000 bond issue for a filtration plant and for water main extension has been approved by the attorneys for Morris Bros., the Portland bond buyers, who were the successful bidders for the bonds, and they will at once be sold and the work of building the filter and of extending the mains will go ahead.

MODESTO, CAL.—The Board of Trustees met in adjourned session and after some discussion the ordinance, calling for a special election Tuesday, September 6th, for the purpose of voting on a bond issue of $100,000 for public improvements was introduced. For the acquisition, construction and completion of a sewers system, $65,000; for waterworks, $15,000; for the construction of street work, $10,000.

TRANSMISSION.

STEVENSON, WASH.—The Skamania Light & Power Company is preparing to extend its lines to Carson at once.

SAN FRANCISCO, CAL.—Steps are to be taken immediately to add 10,000 h..p to the capacity of the Great Western Power Company plant at Big Bend.

COQUILLE, ORE.—Fire recently destroyed the lighting plant of the Johnson Lumber Company's sawmill, causing a loss of $50,000. The plant furnished light for this place and Myrtle Point.

MYRTLE CREEK, ORE.—Negotiations have about been completed for the purchase of the plant of the Myrtle Creek Water, Light & Milling Co. by J. L. Blaisdell of Portland. The smaller plants will be eliminated and their places taken by transformer sub-stations, etc.

SAN ANDREAS, CAL.—Engineers have begun on the final plans and field work by the General Electric Power Company on power sites in Calaveras county, which control sufficient water to generate 60,000 h.p. Le Grand Brown, a consulting engineer from New Ycrk, is in charge of the present work.

SACRAMENTO, CAL.—The Great Western Power Company has contracted for nearly all the power that it originally estimated to produce. Up to date, contracts have been signed for about 50,000 h.p. along the route of delivery. Manager Hillborn, local representative of the company, says that immediate steps will be taken to add another unit to the 10,000 h.p., capacity of the plant.

ILLUMINATION.

LOS ANGELES, CAL.—The City Council has employed an engineer to give an estimate of cost of erecting a gas plant to supply the entire city.

OREGON CITY, ORE.—An ordinance has been passed authorizing the City Council of Oregon City, Oregon, to enter into a contract with the Portland Railway, Light and Power Company, to light Oregon City from the first day of September, 1910, to the first day of September, 1915.

SAN DIEGO, CAL.—The people of San Diego have decided against municipal ownership. At the election 19 out of 20 propositions submitted to the people were adopted and the 20th and last, a proposition to bond San Diego for a municipally owned and operated gas, electric and power plant, was defeated by a vote of five to one.

SPOKANE, WASH.—Spokane capital will build a water power electric plant at Three Forks, Gallatin county, Mont., to furnish water, electric light, power and heat. It is estimated that the plant will cost in the neighborhood of $200,000. Associated with a Spokane syndicate is said to be Senator Joseph M. Dixon of Montana.

ASHLAND, ORE.—The Council has passed an ordinance granting to J. R. Allen the right to lay down and construct, operate and maintain and use railway poles and wires, and underground conduits and conductors in the city of Ashland, Ore., to operate cars and locomotives other than steam, to generate and transmit power, and to send and receive messages by telegraph and telephone over certain streets in the city of Ashland, Oregon.

SAN FRANCISCO, CAL.—A petition for the dissolution of the Union Light & Power Company, which for the last five years has held franchises and power rights on the eastern slope of the Sierra Nevada Mountains, has been filed. Out of the 1,515,748 shares issued, 1,505,266 were represented at a company directors' meeting on July 6, which authorized the dissolution. Following are the officers and directors of the company: Charles H. Hammon, president; A. E. Boynton, secretary; A. L. Dahl, Ray Marrows, C. F. Mettier, H. C. Mack, H. S. Goodfellow, directors.

ALLEGHANY, CAL.—The sub-station of the Middle Yuba Hydro Electric Company is being constructed in Buckeye Diggings near Smith's Flat, and the agent of the company says he will be ready to deliver electricity throughout Alleghany by September 15. The company is reconstructing the road on the Lafayette ridge between the Croesus mill and the Plumbago mine in order to facilitate the transportation of material for the new plant in American Hill. It will be two years before the latter is completed. In the meantime the company will rent its power from the Pike City plant.

TRANSPORTATION.

GRANTS PASS, ORE.—It is reported that the Coos Bay Traction Corporation, with an authorized capital of $1,000,000 will construct a line from Coos Bay to Grants Pass with a branch to Roseburg.

POMONA, CAL.—The $5,500 required to purchase right of way from Claremont to Pomona for an electric railway has been raised and the road will be in operation December 1st. It will be the Pacific Electric Railroad Company's line.

SEATTLE, WASH.—It is announced that the Bainbridge Development Company will begin construction on its proposed trolley line on Bainbridge island about December 1. M. B. Jackson, Jr., 409 Bailey building, is president of the company.

LOS ANGELES, CAL.—The City Council yesterday authorized publication of notice of the sale of an electric street railway franchise along Evergreen avenue from Brooklyn avenue to Blanchard street and thence along Blanchard street to the easterly boundary of the city.

PORTERVILLE, CAL.—An official of the Holley railroad makes the statement that the Porterville- Coalinga Electric Railroad Company has $3,000,000 in cash available for the construction of a railroad from this city to tidewater. Preliminary surveys have been made of the road which has been planned to run from Porterville through Tulare, Hanford and Coalinga, with a branch from this city to run also through Lindsay, by way of Frazier valley, through Exeter and other small settlements to Visalia. Sites for power plants have already been secured on the Upper Tule river and it is proposed to equip the entire road electrically. The officials, which include J. J. Vossburg, orange grower of this city and Charles Eiester are among the incorporators of the road.

TELEPHONE AND TELEGRAPH.

NEZ PERCE, IDAHO.—The Nez Perce Telephone Company will build a line from Vollmer to Cottonwood.

KLAMATH FALLS, ORE.—The Council has passed an ordinance granting to the Pacific Telephone & Telegraph Company a franchise to conduct its business in this city for a period of 25 years.

SAN LUIS OBISPO, CAL.—Negotiations have been consummated whereby the two Home Telephone Companies located at Whittier and Downey have been added to the system of the Pacific Telephone Company.

YREKA, CAL.—A petition of the Cedar Park Rural Telephone Company for permission to erect and maintain a telephone line along the public highway in a northerly direction from Mayten for a distance of about 10 miles, etc., has been granted.

MANTON, CAL.—The Volta power house is putting in a wireless system to be used with the Redding, Shasta county, power office. This will be used mostly during the winter, when the wires of other systems are down during the heavy snowfalls.

SAN FRANCISCO, CAL.—The Santa Fe has ordered apparatus to equip 460 miles of its line with telephones for dispatching trains. The outside construction work is already under way and eventually all traffic and all train movements on the Santa Fe will be directed by telephone. At present 2275 miles of the line are so equipped.

SAN FRANCISCO, CAL.—The Western Union Telegraph Company, under Charles H. Gaunt, the new general superintendent of the Pacific Division, has leased the four upper floors of the five-story building at 250 Montgomery street adjoining the San Francisco main office. A great deal of additional office space will be occupied under the new three-column organization that is being inaugurated. Many improvements in the plant as well as office arrangements will be made in San Francisco, Seattle and elsewhere in the nine States of the Pacific Division. This is admitted to be one of the most important of the four sections into which the United States is divided by the company.

TRUCKEE, CAL.—George Walling, George Carter, Lawrence Carter and Marcellus Fischer of Nevada City are here to repair and rebuild telephone lines in this section. They will do the work for the Tahoe national forest, which is building a complete system hereabouts and when they finish, communication may be had with the ranger stations resorts.

PORTLAND, ORE.—The United Wireless Telephone Company has announced the discontinuance of its stations at Portland and St. Helens. This completes the elimination of the land offices of the company, which, in the Northwest at least, will hereafter confine itself to the stations along the coast. The station at Astoria, well situated for communication with vessels, will become a 24-hour station.

KLAMATH FALLS.—At the meeting of the City Council last week a 25-year franchise was granted to the Pacific Telephone & Telegraph Company. L. H. Newton, who is here looking after the interests of the company which took over the plant from the Midway Telephone Company recently, states that his company will have engineers in the field within a short time working out the plans for the proposed improvements.

WATERWORKS.

JOSEPH, OREGON.—J. M. Mitchell of Joseph will install the Joseph water system for $16,800. It is the intention to connect the large main with Wallowa Lake, a mile south, and above the town which will give ample force for all purposes.

SAN JOSE, CAL.—Judge Welch has denied the motion of the Bay Cities Water Company which is the defendant in an action brought by the Hayes-Chenoweth Company to restrain it from diverting the waters of Coyote Creek, so to amend its answer as to narrow the issue to its use of the surplus waters instead of the entire flow. The question of riparian rights involved was settled in a similar suit against the company a few years ago, when Superior Judge Rhodes decided against the company. This ruling was subsequently affirmed by the Supreme Court.

SAN FRANCISCO, CAL.—City Engineer Manson has filed a report embodying statements of interest in connection with the daily consumption of water. The average daily consumption for June, according to the report, was 38,100,000 gallons, a considerable increase from the 35,700,000 gallons representing the average consumption for the corresponding month last year. The maximum daily consumption during June of this year was 41,200,000 gallons, as against a corresponding maximum of 40,100,000 for June, 1909. The increase in the June daily consumption, the City Engineer notes, is the more worthy of attention in view of the fact that the month named was comparatively cool this year. The minimum daily consumption this year was 34,700,000, occurring in January last, the corresponding minimum for last year was 32,600,000 gallons. The report calls attention to the fact that there is every reason to anticipate a group of warm weeks during August, September and the early part of October during which the maximum daily consmption for June mentioned, much as it exceeds the average daily supply now available, 36,000,000 gallons, is likely to be still further exceeded. There is, in fact, he suggests, an evident minimum increase of 2,500,000 gallons daily provided for each year for several yet to come.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 9 | SAN FRANCISCO, AUGUST 27, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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VOLUME XXV — SAN FRANCISCO, AUGUST 27, 1910. — NUMBER 9

ELECTRIC POWER IN THE CONSTRUCTION OF THE LOS ANGELES AQUEDUCT[1]

BY E. F. SCATTERGOOD.

Excavation in Los Angeles Aqueduct

The Los Angeles aqueduct extends from the intake in Owens valley, about 12 miles north of the town of Independence, to the storage reservoirs at the head of the San Fernando valley, about 24 miles distant from the city of Los Angeles, from which point the city water department will take care of the distribution of the water. The length of the aqueduct proper is, therefore, 240 miles.

From the southern end north to the north portal of the Elizabeth lake tunnel, a distance of 35 miles, the work is heavy, being to a considerable extent composed of tunnels, including the Elizabeth lake tunnel,

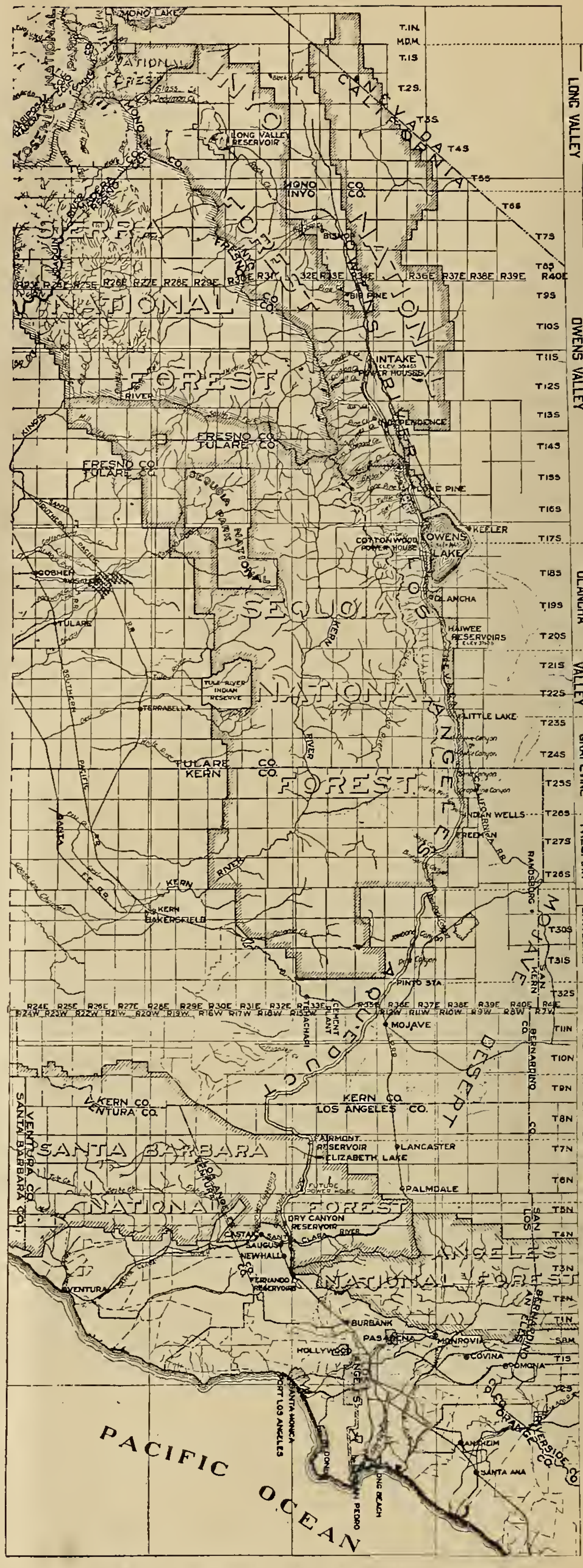
[1]Paper presented before the Los Angeles Section of the American Institute of Electrical Engineers, March 22, 1910.

some 27,000 ft. in length, through granite rock. Preliminary estimates showed that in such sections the considerable amount of power required could be furnished much more cheaply, from a central generating plant and distributed by high tension transmission, than by small power generating units, either by steam or distillate engines at various points as required. This section is supplied with power purchased from the Southern California Edison Company, and delivered at one of its sub-stations about four miles west of the aqueduct line and near the center of this section. From the Elizabeth lake tunnel to a point 55 miles further north, the aqueduct follows along the desert in the open, and estimates indicated that the conduit excavation, and concrete work of lining and cover, could be done more cheaply with the use of steam shovels and gas engines than by the erection of a temporary electrical generating and distributing system. From the Pinto hills north to the intake, a distance of 150 miles, there are alternate sections of the heavy tunnel work and of the lighter conduit work. In the Owens valley there are numerous creeks flowing down the eastern slope of the Sierra Nevada mountains offering excellent opportunities for power in sufficient quantities for construction work on the aqueduct; and estimates showed clearly that power could be developed at these creeks and transmitted along this 150 miles, and delivered to all points requiring power, in large or small amounts, at a very much lower cost than that for which it could be furnished in any other way.

It should be stated for the benefit of those who are not so familiar with the city's project, and who may read this paper, that the power referred to here is for construction purposes only, and should not be confused in any way with the large amount of electric power which may be developed along the line of the aqueduct when it is in operation, and which will total a peak load capacity of 120,000 h.p. delivered at step-down voltage in the city.

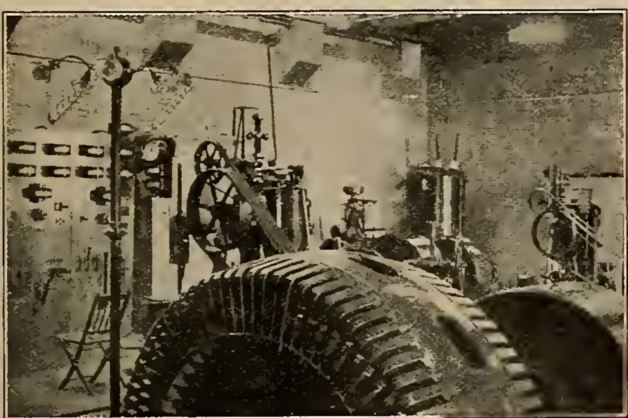
Power System.

For the purpose of supplying power along the section of the aqueduct from the intake to the Pinto hills, hydroelectric plants were installed on Division and Cottonwood Creeks. The Division Creek plant is about three miles south from the aqueduct intake, and has a rated capacity of 600 kw. The works at the point of diversion at the creek cost $1214. The penstock starting from this point, and extending down the slope 10,500 ft., consists of 6291 ft. of 18-in. riveted pipe and 4209 ft. of 15-in. lap-welded pipe, and cost, in place, $28,102. The effective head obtained is approximately 1200 ft. The power house equipment consists of one tangential wheel direct connected to a 2200-volt, three-phase, 600 r.p.m. generator and a bank of transformers, stepping the voltage up to 33,000, each of which has a continuous overload capacity of 25 per cent above the 600-kw. rating. The power house is built of concrete in a substantial manner. This is also true of the second one to be described, as these plants are intended to become a part of the permanent aqueduct power system. The cost of the power house and equipment, including three cottages, etc., is $21,100, making a total cost of approximately $84.50 per kw., or $63 per h. p. rated capacity at the switchboard.



Map of Los Angeles Aqueduct and Adjacent Territory.

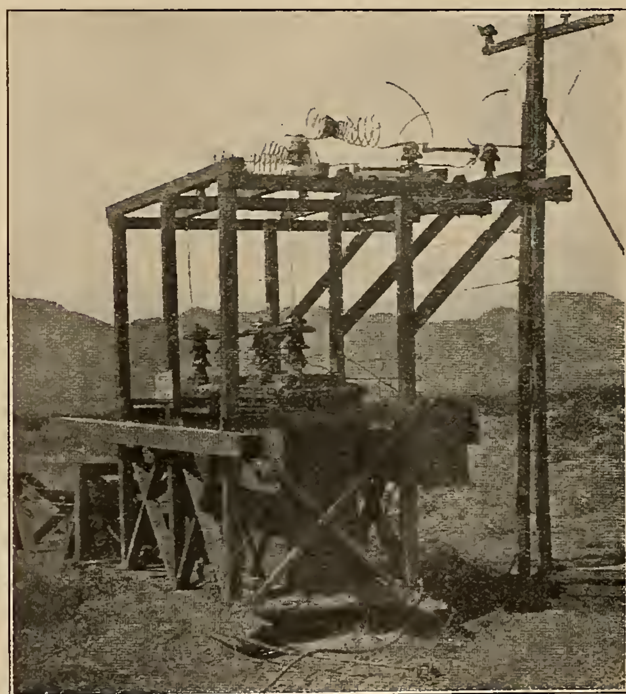
The Cottonwood power house is approximately 40 miles south from the Division Creek plant. Its equipment consists of two tangential wheels, operated under 1200 ft. effective head, each direct connected to a 750-kw. three-phase, 2200-volt, 600 r.p.m., generator, each of which in turn is connected to the 33,000-volt line through a separate bank of transformers. The works at the diversion point cost $3964. The canyon for a distance of 3750 ft. is so precipitous as to make a conduit or tunnel impracticable within reasonable cost, therefore, a 24-in., No. 12 gauge, riveted pipe was buried along the side of the canyon, at a cost of $9352. From this point to the forebay, a distance of 7042 ft., a covered concrete conduit, 30 in. by 20 in. inside section, was constructed on the mountain side at a cost of $11,228. The penstock, with 523 ft. of 24-in. pipe and 4009 ft. of 22-in. pipe, or a total of 4532 ft., cost $29,820. The power house and camp complete cost $49,638, making a total of $69.40 per kw., or $51.75 per h.p. of rated capacity at the switchboard, the plant having 25 per cent overload capacity.



Cottonwood Power House—two 750-kw. generators—Power all utilized for Construction Work.

The transmission line is 151 miles long, and is made up of three No. 4 bare copper wires; two-part seven-inch porcelain insulators with iron thimbles, pins and bases; one wire on a 15-in. crossarm at the top of a 30-ft. pole, and two on a 6-ft. crossarm below, and poles spaced 180 ft. apart. The average cost of this line is $862.50 per mile. About one-fifth of this line is through rough mountainous country, and the wagon haul for the entire line an average of 12 to 15 miles. This line has since been extended from its southern end to the aqueduct cement plant, a distance of 17 miles, with No. 2 copper, at a cost of $1050 per mile. The object of this extension is to deliver surplus power to the cement plant, with the advantage of supplementing the steam plant, thus saving fuel oil and making the entire system more flexible and reliable by running in parallel with two 750-kw. steam turbines at that point. Had the cement plant been contemplated originally, more copper might have been used along the whole line, and more generating capacity installed to advantage. As an interesting illustration of the value of synchronous condensers in connection with transmission of electric power, it may be stated that while delivering a distributed load of 1000 kw. between the intake and the Pinto hills, 400 to 420 kw. could be delivered at the cement plant, 125 miles from Cottonwood at 30,000 volts with 35,000 volts at Cottonwood when not in parallel with the steam turbines; and that 800 kw. can be delivered at the cement plant when running in parallel, by strengthening the field of the turbo-generators, with the same voltage drop and the same distributed load along the line.

There are about 74 step-down transformers connected to this line in banks of two or three; most of these transformers are of 40 kw. capacity, the remainder are either 20 kw. or 80 kw. The greater number are of the out-door type, which have given excellent satisfaction, and are very much liked by the men in charge of work, because of the decreased expense and time of setting them up. Most of them have been shipped from the factory with the oil in them, as they are in boiler iron cases, made suitable for moving with the oil in place, thus avoiding the necessity for drying out of transformers at isolated places. The protection of this high-tension line against lightning and surge voltages is a combination of low-equivalent arresters at the Cottonwood power house and three sets of horn-



33,000-Volt Portable Sub-Station—outdoor type transformers.

gap arresters at other important places. The transformer stations are protected by air-insulated choke coils and fused horn-gap switches. The comparatively small insulators for the voltage used, while they have given no trouble whatever, do undoubtedly serve to give additional protection to apparatus along the line by affording relief from any excessive potential. No apparatus has been lost from lightning or surges during the eighteen months of its operation.

By including interest, placing a proper depreciation on the permanent power plant, and assuming a low value of return from the copper on the temporary line, and on the transformers constituting the sub-stations, (the system to be in use but four years), it was estimated that the cost per kilowatt hour delivered at a step-down voltage, in large and small quantities

as desired, would be approximately 1.15 cents. The indications are that this estimate will prove to have been conservative.

Uses of Electric Power.

Stating as briefly as possible the uses to which this power is put; there are in Owens valley about 20 miles of the aqueduct which can conveniently be built with dredges. Four electric shovels are in use for conduit excavation in the open country. One mill for regrinding tufa with the cement is located at Haiwee, 22 miles south of Cottonwood. Electric power is used at Haiwee, also for sluicing and other work connected with the building of the earthen dam. There are approximately 18 miles of rock tunnels and three miles of earth tunnels provided for by this power system. The typical tunnel equipment consists of one air compressor, driven by a 100 h.p., 440-volt, three-phase induction motor; one 80 kw. motor-generator set, providing 250-volt direct current for electric locomotives; lighting and other work inside the tunnels; other power for blowers, machine shop, hoists, pumping, etc., as the case may be, and for lighting camp. In case electric locomotives are not used, as in shorter tunnels, alternating current at 110 volts is used for lighting in the tunnels also.

Dredges. There are two suction dredges in operation in Owens valley, each equipped with a 12-inch centrifugal pump, driven by a 100 h.p., 440-volt induction motor; one 40 h.p. motor to run the cutter, one 40 h.p. motor to run the jetting pump for breaking down the bank over the cutter, and one 20 h.p. motor for operating various hoists. There is also one dipper dredge of one and one-half yards capacity of the friction type, driven by one 100 h.p. induction motor. The step-down transformers in each case are mounted on a float, with the rack overhead supporting the choke coils and switch on which the taps from the transmission line land. The line being close by requires but one short span, and a crossarm is placed on the round cedar pole by clamping it with two bolts and a short piece on the back, and then safety is insured by pushing up at a safe distance from the lower arm. Connection is made with the line through long spiral springs of tempered brass and a brass slip at the end. These are put in place by means of a long pole from an insulating stand, or by climbing a short distance up the power poles, with the line switches at the transformers open, and the transmission line hot, which necessity requires, and which cannot result in personal harm when done by an experienced lineman, as is the case. The connection from the transformer float to the dredge is made by means of a three-conductor submarine armored cable. The cable is stored on a reel on a second float attached behind the dredge, with flexible connections to the dredge, so that the cable is automatically paid out, and when all out the flexible connections are detached and the cable wound up, then the reel float and the transformer float are towed up to the dredge together. This method has proved very satisfactory in avoiding abuse to the cable and in saving time and expense in moving.

Electric Shovels. Electric shovels with three-quarter yard buckets, and 25-ft. booms, used for conduit excavation, are of the friction type, driven by one 75 h.p., 2200-volt induction motor. The step-down transformers are mounted permanently on sleds or trucks, with the racks supporting the choke coils and switches permanently fixed overhead, and with two 10 kw., 2200 to 440-volt transformers attached, supplying power for concrete mixers operated in connection with each shovel. The cable used is three conductor No. 10 with rubber insulation, rounded out with jute, taped with weather-proof braid and half round steel armor over all. This connects between the transformers and the shovel and between the temporary 440-volt line on the power poles (about 1000 ft. back from the transformers) and the mixers, and is giving excellent satisfaction. The considerable advantage experienced with the use of out-door type transformers in connection with dredges and shovels is very evident.

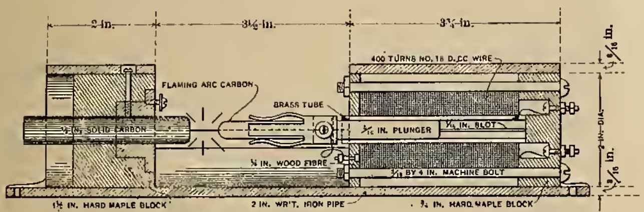
Electric Locomotives. Twelve three-ton electric locomotives rated at 1200 lb. draw-bar pull at six miles per hour are in use in this section of the aqueduct. At each end of the Elizabeth tunnel, which is not supplied from this power system, there is one locomotive of this size and one six-ton locomotive. In that tunnel, which is approximately 90 sq. ft. in section when lined, the larger locomotive is preferred, making it possible to pull out 14 to 16 cars of muck at one time. The three-ton locomotives are of good size for the tunnels in the section under consideration, which are approximately 70 sq. ft. in finished section, and range from 2000 to 10,000 ft. in length where locomotives are used. The use of electric locomotives in these tunnels results in a reduction in cost of excavation and placing the concrete lining, which is a considerable percentage of their total cost. The actual cost of removing muck and delivering concrete is considerably less than it would be if done in other ways, especially by mules; but the greater reduction in cost is due to the practical condition of being able to get the muck away for the convenience and economic working of the miners in excavation, and allowing the placing of rock crushers and concrete mixers at a convenient point outside of the tunnel for concrete work. Concreting is being done successfully and with perfect satisfaction to the engineers at a distance of 10,000 feet in one instance. This use of these machines makes it possible not only to reduce the cost where speed is not a consideration, but to very materially increase the speed, if desired.

Small Isolated Power. Experience with distillate engines in connection with concrete mixers and other small power has led the men in the field to plead for electric power; for example, several steam shovels are in use in this section for conduit excavation, and it was thought at first that the expense of stepping down the voltage, moving transformers, etc., for supplying two or three motors of 7½ to 10 h. p. each would not be justifiable but the division engineers now insist that the cost of maintaining and operating distillate engines under the conditions experienced along such work is in itself greater than the cost of supplying the electric power, including the charge made against them for the energy, as well as the equipment, beyond the transformers; and they further state that the interruptions which they have experienced in concrete work with distillate engines behind a single steam shovel, as compared with what they have experienced in concrete work with electric

power behind an electric shovel, has cost them anywhere from $20 to $40 a day after the engines had been in use a few months and began to develop troubles under those conditions of operation; in other words, the saving is due to the consideration of reliability aside from actual cost of supplying power to the mixers. The cost for tunnel work is considerably reduced and the speed increased by electric lighting.

Protection Against Gases.

One of the long tunnels in another section runs through an oil district, and at times has developed considerable explosive gases. In order to protect the men against this danger, electric sparking devices have been installed, designed as shown in the illustration. They may be operated either by alternating or



Sparking Device for Exploding Gas in Tunnel

direct current. They are operated by direct current in this case by means of a switch outside of the tunnel, and as may be seen, are absolutely positive in their action and cannot fail if properly trimmed when the miners leave the tunnel. They have exploded gases several times, and in the form shown are usually found intact after the explosion; several of them being in use gives opportunity for further trials before entering the tunnel.

Telephone System.

The telephone system is considered not only one of the most profitable adjuncts to the aqueduct construction, but one which is essential to its economic construction at reasonable speed. It consists of approximately 260 miles of main line from the Los Angeles offices to the intake, built of two No. 10 copper wires strung on redwood poles, at a cost of $188 per mile. This line is divided in three sections by two exchanges, which more than doubles its efficiency. In addition to this there are local telephone systems in each of the various divisions along the work; some of these have as high as 26 telephones. Each local system may be temporarily connected with the main line by a switch in the division engineer's office, there being but one main line telephone on each division. As the telephone system is to be used by all classes of men, very few of them familiar with electrical work, it was thought undesirable, if not wholly impossible, to operate it successfully with the line on the power poles. Estimates showed that by making the poles on the transmission line five feet shorter, the telephone line could be placed on separate redwood poles at an equal or slightly less cost, and this has been done. The telephone lines are in every case placed underground at crossings with high-tension electric lines.

Amount of Power Required.

A good idea of the amount of power necessary to operate the equipment may be obtained by studying the following tabulation, which gives the total rated motor capacity, approximately 3470 h.p., of the various equipment attached to this system, and the total electrical horsepower, approximately 2000 h.p., required at the switch board of the two power plants combined for supplying this system independent of the cement plant. The energy necessary for lighting machine shops and other small requirements is not tabulated, but is included in the power at the switchboard. In many instances power is used 24 hours each day, but in other cases during 16 or 8 hours per day; on an average about 16 hours per day. The amount stated as being required at the switchboard is taken from the heavy load periods during the day; in other words, the average peak load for that work. The average load during the 24 hours would be about 60 per cent of this.

Motor Installation Intake to Pinto Hills.

2	suction dredges	400 h.p.
1	dipper dredge, 1½-yard dipper	1000 "
4	electric shovels, ¾-yard dippers	300 "
	Tufa regrinding mill	200 "
	Haiwee dam, hydraulic work	100 "
8	air compressors, 500 cu, ft. each	800 "
8	motor generators, 80 kw. each	1000 "
7	rock crushers, 10 and 20 tons per hr. each	140 "
28	concrete mixers, 6 and 10 cu. ft. per batch	280 "
7	blowers, 1350 cu, ft. per minute each	70 "
3	hoists	60 "
2	pumps	20 "
	Total rated capacity of motors	3470 "

The average power used at each end of the Elizabeth tunnel, already described, is 88 kw. during the 24 hours, divided, as follows: 5½ kw. for lighting outside the tunnel; 35½ kw. for operating the motor-generator which supplies power for ventilation, electric locomotives, lighting the tunnel and a small amount of pumping from the tunnel; and 47 kw. for compressed air for drilling, machine shop, camp water supply, etc. The average peak is about double the average load.

JAPAN'S HYDRO-ELECTRIC POWER.

It is evident that the central government of Japan has recently come to appreciate the great value and importance of its water-power resources. Heretofore provincial authorities have granted certain water-power rights, but now the central government authorities have taken the matter into their own hands, with the intention of inaugurating a characteristic Japanese system of exact procedure in the conservation of the country's extensive hydro-electric possibilities. The promotion of industries and providing new means of raising revenue are here combined in advancing reasons why the government should inaugurate the new system of conservation.

There has been a rush for water-power rights throughout Japan, and it is now evident that the government proposes to restrict those who are presumed to seek franchises of this nature for purely speculative purposes. American capital is largely interested in hydro-electric enterprises in Japan, and under favorable conditions American capital is ready for large investment in extensive power plants.

THE DIRECT MEASUREMENT OF HIGH RESISTANCE BY A MEGGER.

BY ARTHUR J. ROWLAND.

No matter what the thing to be measured a direct method is always to be preferred. It is not only that the observation is made quickly and the result known at once, but the attention of the observer is fixed on the result he is securing and not taken up with calculation or manipulation in trying to arrive at an intelligent conception of the magnitude of the thing about which he wants to know. There was a day when galvanometers were used for most measurements of current; but now ammeters are invariably applied to any sort of test where their range and accuracy can make them available. Years ago Thomson galvanometers were widely used for switchboard work; no one would think of such an instrument for such a use now. In these days engineers install watt-meters, power factor meters, frequency meters, etc., for the direct measurement of the quantity each can indicate rather than take the trouble to determine them by indirect means.

Among those things which must be known about and measured in dealing with electrical circuits, none is more important than resistance. Yet very little indeed has been done in the way of producing instruments for measuring it. We use volt meters and ammeters and compute it by the aid of Ohm's law; or we take a Wheatstone bridge for the measurement; or perhaps a voltmeter is employed for high resistance determinations. All of these involve indirect methods with well known limitations and faults. There are such things are ohmmeters, but they are scarcely used because the only instruments which have been available have such serious practical limitations that they are nearly worthless.

For high resistance measurements there has been no instrument available in the past except the Evershed ohmmeter which was made and sold in this country for a number of years. It was never much used, probably on account of the various serious inherent defects only too well understood by the inventor; and he turned from it to a prolonged search for a method of building an ohmmeter which should have very much higher sensibility than anything which had been produced before, be dead beat, have a good scale, and be reliable in calibration. He found this in an instrument of the permanent-magnet-moving-coil-type; a true ohmmeter but one with sensibility great enough to make it possible to read directly in commercial instruments of various ranges from an upper limit of 2000 megohms down to 1000 ohms. This instrument is the megger. Its general appearance is shown in Fig. 1. The author's experience with it makes him ready to assert that it is a remarkable instrument in sensibility and accuracy, while it has also wonderful ruggedness. It has revealed to him a great many things which are comparatively unknown regarding high resistance—particularly insulation resistance.

Measuring Insulation.

The measurement of insulation resistance has an importance which seems not to have been properly recognized. People have become so taken up with breakdown tests for determining the reliability of insulation, that the feeling seems to have crept abroad that failures on lines and cables and machinery (particularly for high voltage work) are due to disruptive breakdowns; that a fault suddenly develops, or a breakdown comes by a direct arcing discharge puncturing the insulation. The fact seems to be overlooked that frequently insulation deteriorates gradually, and along with it the leakage current rises through the diminished insulation resistance until at last the local heating and charring brings a time when away goes the whole structure when a vast increase in current occurs, through what has at last become a good conducting path. Breakdown tests are not applied except at the time of acceptance of a piece of apparatus, and anyone who has had experience with them know how unsatisfactory they are. One cannot tell

Fig. 1. The Megger (one-sixth full size).

whether the insulation has all but gone from permanent strain, nor whether under a different set of conditions a breakdown might have occurred. No one would dare subject new apparatus to a breakdown test until he knew its insulation resistance was sufficiently high. The man would not be considered sane who subjected his dynamos or cables to a weekly high voltage test to determine their security for the next succeeding period.

A megger can be applied as often as one pleases to measure insulation resistance without the possibility of any harm coming to the apparatus under investigation, and it may even be an important auxiliary when breakdown tests are contemplated. Take a single example. An oil insulated high voltage transformer is to be installed. Before the oil is put in, the transformer must be dried; because dry insulation and dry oil are essential to satisfactory dielectric strength. Moisture has a wonderful effect in lowering insulation resistance; hence, by the use of a megger it is easy to tell whether much moisture is present, and as the drying operation goes on how effective it is when the insulation has become dry. Or, suppose the transformer is an air cooled type now becoming old. Is it safe to keep it in operation or should repairs be made? A record of insulation resistance taken from time to time would make it possible to tell about this.

Figures 2 and 3 show the interior of the megger.

Fig. 2 shows clearly the permanent magnets so placed that a nearly closed magnetic circuit is formed. At one end is a dynamo armature in which, by turning the crank, the e.m.f. necessary to operate the instrument is generated. At the other end is the mechanism, more clearly shown by Fig. 3, by means of which the indications of the instrument are secured.

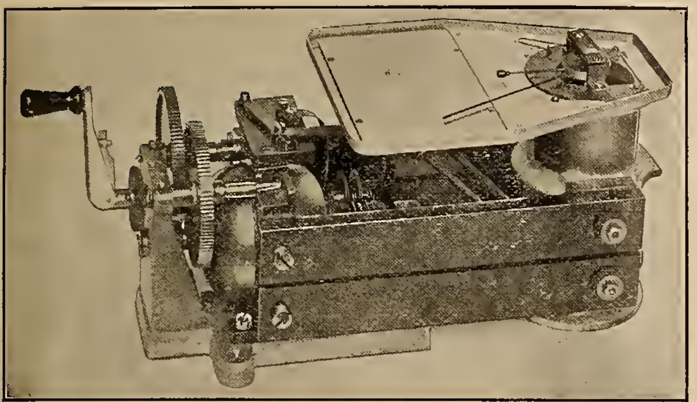


Fig. 2. An Interior View.

In Fig. 4 the magnetic circuit is shown diagrammatically as well as the internal connections of the instrument. When a resistance measurement is to be made the apparatus under test is connected between the binding posts marked "Line" and "Earth" (Fig. 1), or at the point marked "External Terminals" in Fig. 4. The crank is then turned at a convenient speed and the scale reading taken.

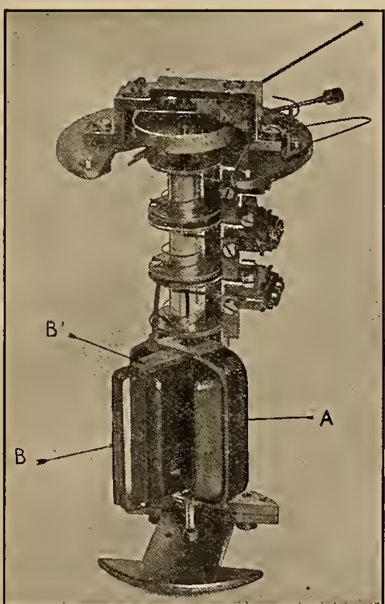


Fig. 3. The Moving System.

A brief explanation may serve to show how the instrument works and that it not only is a true ohmmeter but more true to calibration than most direct reading instruments.

The moving system consists of a coil marked A (Figs. 3 and 4), which is in series with the thing to be measured; and a pair of coils connected in series, marked B and B[1], which with resistance R are connected directly across the dynamo terminals. All three coils are rigidly connected together as indicated in the cuts and current leads are provided as shown in Fig. 3, where very slender copper strips may be seen hung loosely around small spools. These strips oppose a negligible restraining force. There are no springs in the instrument and the needle is liable to stand anywhere along the scale when the dynamo is not in operation. When the crank is turned and an e.m.f. acts, a current flows through coils B B[1] pro-

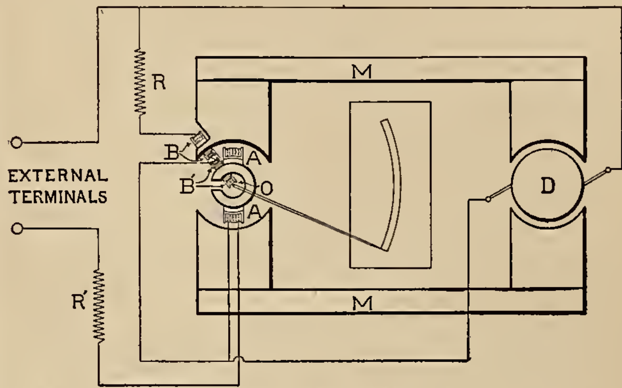


Fig. 4. Magnetic Circuit and Electrical Connections.

portional to it. Suppose nothing is connected between the external terminals. The current in coils B B[1] drives them to a position where the least flux from the permanent magnet field is through them; that is, directly opposite the gap in the C shaped iron piece about which coils A and B[1] move. The needle then stands over the line marked "Infinity" on the scale. If now something having suitable high resistance is connected to the external terminals, current flowing in coil A produces a deflecting torque toward the position in which it is shown in Fig. 4; and as the system moves the coils B and B[1] exert a stronger and stronger restraining torque. Hence a definite position is assumed by the system and needle for the particular resistance connected.

The instrument is a true ohmmeter, since an increase in the e.m.f. would increase the current in both coils the same proportionate amount, and the position of the needle stay fixed. It is dead beat; for the same means are taken to produce this result as in most instruments using a moving coil in a permanent magnet field, and fine results are obtained. It is also constant in calibration because deterioration of magnets can no more influence the position of the needle for a given resistance under measurement than a change in dynamo e.m.f. Time can have no appreciable effect since the case is not only dust proof, but the moving system is completely enclosed in an aluminum casting where neither dust nor moisture can reach it.

When measuring apparatus having considerable capacity, it is necessary to have a fixed e.m.f. so that charging and discharging currents shall not distort the reading of the instruments. This is provided by a friction clutch interposed between the armature and the driving gears. Above slipping speed of this clutch the dynamo e. m. f. is constant within half of one per cent.

The instrument, although made in England for several years and widely in use there and on the continent in much important work by the best of engineers, has hitherto been scarcely known in America. Complete information regarding it may be obtained from J. G. Biddle, 1114 Chestnut Street, Philadelphia.

BURNING FUEL OIL ON SHIPBOARD.

The following notes on oil burners are condensed from a paper on "Fuel Oil Installations and Tests Made on U. S. S. 'Cheyenne,'" by F. F. Ingram, published in the May, 1910, Journal of the American Society of Naval Engineers. This is published as supplementary to the series of articles on "California Fuel Oil" which are being written by R. F. Chevalier and in which details will soon be given of all other makes of Pacific Coast oil burners besides the two herein described. Mr. Ingram's advocacy of the outside mixer as compared with the inside mixer is open to a discussion for which the columns of the Journal are freely offered.

There are a great many devices on the market for burning fuel oil. The oil found in California and many western States contains an asphaltum base, which makes it impossible to use mechanical burners, because the asphaltum and carbon are readily deposited when the oil is highly heated and close the small appertures in the mechanical burners, necessitating frequent cleaning and removing and causing a fluctuation of steam and a great deal of annoyance to the attendant. With Pennsylvania and Ohio oils this difficulty is not experienced, as paraffin is the base, and superheating the oil assists its combustion.

The type of burner used on the Pacific Coast is adapted to both paraffin and asphaltum bases, two general types of burners being used—an outside mixer, or atomizer, and an inside mixer, or vaporizer. Both have their relative merits and deserve mention.

The outside mixer or atomizer is simple in construction. There are no parts to get out of order, and there is no internal deposit of carbon and asphaltum in the oil passage, the oil being kept under pressure until it reaches the combustion chamber, when it is released at right angles to the atomizing agent in the open combustion chamber. No adjusting of parts is necessary except to vary the amount of oil to suit the load being carried. With outside mixers the oil and atomizing agent do not come in contact with each other until they reach the combustion chamber, and a small percentage of water in the oil does not interfere materially, as the water contains enough oil to keep the burner lighted. The oil being superheated to 230 degrees in the burner immediately evaporates any water that is held in suspension in the fuel oil. With outside mixers there is no sputtering or series of explosions, so objectionable and annoying to the attendant.

Fig. 1 shows an outside mixer or atomizer of the type used in the U. S. S. Cheyenne. This burner has given very good results. The oil is kept under a constant pressure of 50 pounds and the atomizing agent at 70 pounds. The oil passes through a heater that has a steady pressure in its jacket of 50 pounds per square inch. The temperature of saturated steam at 50 pounds pressure equal 281 degrees F., consequently the oil is kept at a high temperature. It is further heated by passing through the superheater 3, in the burner, where the atomizing agent surrounds the oil. This further adds to the already superheated condition of the oil, and upon being released in the combustion chamber at right angles to the atomizing agent it instantly becomes a gas and burns with a soft, white incandescent flame, almost noiseless except when being forced. Fig. 2 shows the head of burner. When the oil is delivered through the small hole 5/32-in. in diameter, the oil is retarded by the baffle plate 1, and forced through the circular passages into the annular opening 4, where the atomization agent comes in contact with the oil; a handle is also fitted to these burners to facilitate handling when hot. After being placed in position the handle is detached. To clean these burners, remove the baffle plate and clean the obstruction from the circular grooves; with good oil these burners do not require to be changed for weeks.

The U. S. Tug Navajo is fitted with the Ingram type of outside mixer or atomizer, and on a recent trip from San Francisco to San Diego, a distance of 500 miles, these burners were not removed from the furnaces nor did they require cleaning during the entire

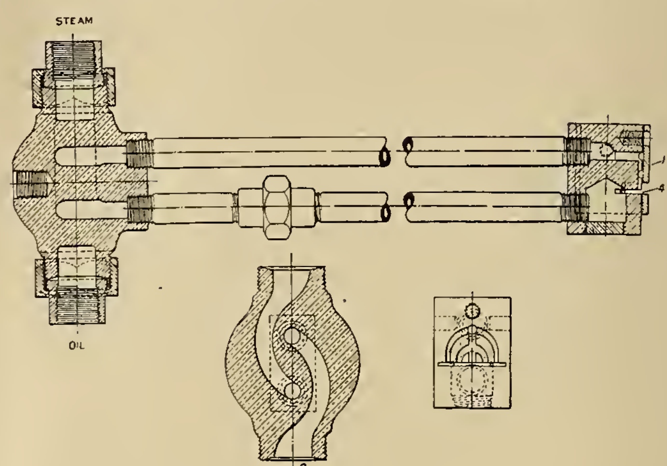


Fig. 1.

trip. Steam was maintained at a steady pressure and smoke was not seen during the trip, showing that combustion was perfect. The U. S. Tug Umatilla and the U. S. Monitor Cheyenne, also steam launch and galleys, are equipped with Ingram burners. Coal was not used on the U. S. S. Cheyenne for four months previous to going out of commission at Mare Island.

With inside mixers or vaporizers the steam or other atomizer comes in contact with the oil in the internal portion of the burner. The oil is contained in a pipe 3/8-in. diameter inside of a pipe 1 in. in diameter. The steam surrounds the oil pipe, therefore heating it to a very high temperature. The oil passes out at the small holes in the mixer where it comes in contact with the steam. It passes through to the mixing space where it is given a circular motion by rifling in the mixer head. Then it passes to the burner tip and is admitted into the combustion chamber in the saturated condition. A soft, white incandescent flame is the result. With careful regulation the inside mixer gives excellent results, but when forced it has a tendency to smoke and show a red flame, because more oil is being admitted to the burner than it can vaporize. There are many parts to the inside mixer which require a certain amount of skill to take apart and put together again. An objectionable feature is the packing in the burner, as the high temperature of the metal has a tendency to burn the packing, thereby causing it to leak steam into the oil passage. Care

must be exercised with inside mixers, as any increase or fluctuation in the pressure changes the mixture of the gas and causes it to go out or to sputter or give off a series of explosions, giving notice that it needs attention.

With inside mixers water in the oil has caused annoyance, and it has been proven that oil containing 1 per cent of water cannot be burned with inside mixers without giving a great deal of trouble and smoke, sputtering, and finally going out. In another boiler using the same oil, same atomizing agent, same conditions except that an outside mixer was installed, no change seemed to occur except that the oil valve had to be opened a little more.

An inside mixer type of burner of the Staples & Pfeiffer design has been used constantly on the Pacific Coast for a number of years and given excellent results. Troubles encountered with this type of burner are not always due to the burner, but in many cases due to faults in other parts of the installation. Great care should be taken to see that an excessive amount of air does not enter the combustion space, causing an undue amount of waste by heating the surplus air. Too little air will be easily detected by the furnace showing a dull red flame, indicating that not enough oxygen is supplied to consume the gases.

Advantages of Oil Firing.

With fuel oil a steady pressure can be maintained and hence more uniform and efficient results obtained at the engine than with coal. With coal it is necessary to open the furnace doors at short intervals to allow for coaling, slicing, raking and cleaning fires, causing a fluctuation in the steam pressure, besides allowing a great rush of cold air to strike the heated tubes, which produce unequal strains on parts of the boiler exposed to the cold air, thus causing the tubes to warp and bend and even leak. With oil fuel it is not necessary to open the furnace doors, as peep holes are provided in the furnaces over each burner, enabling the attendant to watch the burner.

It is desirable in ships of war to get up steam in a hurry. On one occasion a boiler was connected up in 26 minutes from cold water. There is also the advantage that on cutting a boiler out or securing boilers, when fires are extinguished the fuel expense ceases and the boiler ceases to steam. Valves can be closed and ash-pan secured, damper closed, there is no further trouble; no fires to haul, no ashes to care for and get in bilges to stop up strainers; no grate bars to renew; no tubes to sweep, nor paint work to scrape when coming to anchor. With oil all such worry and labor is avoided and the labor for coaling ship is reduced to two men. With oil a hose is led to the filling valve on the outside of the ship, the pump is started and a manipulation of the valves is all that is necessary. Three hours is all that is needed to supply 1485 barrels of oil, where in a former commission it required the ship's company all day to take on 388 tons of coal, besides a whole day to scrub and clean ship and the next day for the men to remove the coal and dust from their bodies and clothes.

Installation.

There are no given or set rules for the bricking or arrangement of the interior of the furnaces. With tubular boilers the custom is to have the grate bars in and construct a blind wall under the front row of grate bars, near their further end to prevent the air from passing into the back connection. The grate bars are covered with a layer of fire brick. A few bricks are omitted directly under the burner to allow of sufficient air to pass in for combustion. It also tends to superheat the incoming air.

With water-tube boilers the usual practice is to remove the grate and bearing bars and construct a bridge wall in front, with occasional holes to allow sufficient air to pass to the combustion chamber. In large combustion chambers pyramids of open brick work are often constructed, as they assist combustion by giving off a glowing heat. No general rule can be followed for installation, as conditions vary. Chimney heights have to be taken into consideration. Baffling and bricking should be done to suit the individual plant.

A great deal of fuel is needlessly expended in smoke and on account of defective installation. When insufficient air is supplied a certain amount of gas must pass off unconsumed into the atmosphere in the form of smoke. If we could remove the carbon and sulphur from the smoke we would have smokeless burners. Uusually it is the fault of the installation, and not the burners, that causes smoke. If the burners are turned down sufficiently, so as to eliminate smoke, you may know that the supply of air is nearly right, but this will produce a drop in the steam pressure, as the oil must be turned on smoke or no smoke. Many plants are installed without regard to economy because a contract has been awarded to the lowest bidder, and he in turn installs the plant in the most convenient manner to suit his own pocket-book, regardless of economic results. A certain evaporation efficiency is usually guaranteed per pound of oil, but few plant owners care to go to such trouble or expense to prove the truth of this boasted guarantee.

A reducing valve should be installed on the steam line leading to the burners, thereby causing steady and even pressure at the burner. With the boiler pressure on the burner a slight fluctuation in the pressure causes a change in the adjustment. After months of experimenting at different pressures on oil and steam, a constant pressure of 70 pounds on the steam and 50 pounds on the oil gave good results, and these pressures were adopted by the inventor. After the burner is once adjusted to the load no further adjustment is necessary.

All fittings on pipes 3 ft. and up should be made with screwed flanges beaded over into a counterbore. Gaskets of rubber should not be used, as the oil dissolves the rubber and causes leaky joints. A piece of No. 1 canvas shellaced on both sides and made up wet will never give any further trouble. Seven threads on all piping where oil passes through should be made up with shellac. Means for getting rid of an accumulation of water in the oil should be provided, as water causes sputtering and intermittent explosions.

Foreign substances in the oil cause a lot of annoyance to the attendant. Strainers or filters composed of fine gauze wire around the basket of the strainer, and placed so as to be easily gotten at to clean these strainers, should be on the discharge line from the fuel-oil pump to the burner. Magnesia and dirt are hard to

burn and are prime factors in plugging up the holes in the burners.

A separate line should be employed for filling tanks and double bottoms on ships, thereby not interfering with the suction from any tank. The suction line should be placed as low down as possible, and the pumps should be installed in such a manner as to prevent any great lift on the suction side. Means should also be provided for proper ventilation of all tanks. Vents should be carried sufficiently high so as to avoid ignition of vapors. Gate valves on all suction lines prevent undue friction, as they can be opened to their full area. Globe valves are not so well adapted to oil as gate valves, as cold oil flows sluggishly. Restricted areas and short bends in pipe and fittings cause undue friction, thereby retarding the flow of oil. Ships that cruise in Northern latitudes are fitted with a steam coil in their fuel tank, so as to assist the pump in delivering the oil to the burners by rendering it more fluid.

Great care should be exercised in regard to leaky joints, as disastrous results might occur from an accumulation of gas in bilges and bunkers. The oil lines in the fireroom space should be examined once each week for leaks. Great care should be taken around the furnaces while changing burners to see that no oil valves are left open. Burners should never be allowed to remain in dead or cold boilers, as the oil valve might accidentally be opened, causing the oil to flow into the furnace unnoticed; a formation of gas and an explosion might be the result of someone's carelessness. The usual method is to have a rack. When the burners are removed from the boilers they are cleaned and placed in the rack, where they remain until required for use.

Combustion of petroleum, like that of all gaseous fuels, can be carried on with a much higher degree of efficiency than that of solid fuel. While the calorific value of 1 pound of oil is as 1.37 to that of a pound of bituminous coal, and 1.63 to that of a pound of anthracite coal, in actual practice it is found that one pound of oil is fully equivalent to 1.8 pounds of coal.

There are three further advantages in the use of oil apart from the direct cost of fuel. First there is the economy of labor in attendance at the boiler, owing to the larger consuming capacity of a boiler, because the heat is applied continuously without any interference or interruption compared to that of applying the coal on a furnace of an ordinary boiler, then there is the absence of smoke and cinders, or waste of any kind, compared with the smoke and ashes and refuse left from coal; and lastly, the cleanliness and ease of manipulation at the furnace.

In oil-fuel burning a high furnace temperature gives more perfect combustion, and it requires less force to atomize the oil. With a properly arranged furnace, very little steam or air pressure is necessary for atomization, because the heat from the glowing brick work immediately converts the petroleum into an oil gas, and sufficient oxygen being admitted to the furnace is all that is necessary for complete combustion. The ash pan should be arranged with a door that could be adjusted to suit the amount of air necessary for combustion, which can easily be seen by an experienced fireman. A clear, white, incandescent flame burning up to the tip of the burner denotes proper combustion. Means should be provided to heat the incoming air before coming in contact with the oil gas. Different methods are used to obtain these results, but general practice will determine the most suitable arrangement for each individual installation, as conditions differ in most plants that were originally equipped for coal.

Smoke consists of the combustible and incombustible products evolved in the combustion of fuel oil, and is composed of such portions of hydrogen and carbon of the fuel gas as have been supplied or combined with oxygen, and, consequently, have not been converted into a carbonic acid; the hydrogen so passing away is invisible, but the carbon, upon being separated from the hydrogen, loses its gaseous character and returns to its elementary or organic condition, that of a black pulverized carbon, and as such becomes visible and passes up the stack in the form of unconsumed carbon, or smoke. Carbon dioxide is the result of perfect combustion; carbon monoxide is that of imperfect combustion. One pound of carbon combines with 2.5 pounds of oxygen and produced 3.5 pounds of carbonic acid.

An insufficient supply of air causes imperfect combustion and causes the unconsumed gases to be given off in the form of smoke, while an excess of air causes a waste of heat.

The volatile products of oil gas in the furnaces are "carbureted hydrogen" and olefant gas, which, upon combining with the oxygen of the air, becomes carbonic acid.

Theoretical or complete combustion teaches us that for every atom of carbon and for every atom of hydrogen there should be at least one atom of oxygen brought into contact with each other, and then subjected to a temperature sufficiently high to ignite them. The only way carbon can be burned is by diffusion of the gases, whereby the molecules are brought into close contact with each other. But this diffusion requires time, as the gases are constantly being cooled by the incoming air, and carried away by the uptakes before being sufficiently heated; and, not reaching the point of ignition, the particles pass up the stack in the form of dense black smoke. An excess of air entering the furnace is a waste, especially with fuel oil, as too much air cools the furnace sufficiently low to retard the proper commingling of the gases. The incoming air should, if possible, be superheated before coming in contact with the oil gas. A portion of the air is heated by coming in contact with the brick work inside the furnace, which, under ordinary conditions, is very hot. Therefore it is evident that with the fuel oil installation forced or induced draft is not to be considered economical, as the open furnace allows the incoming oil to flow to the combustion chamber with such velocity that the gases are cooled below the ignition point and pass off unconsumed. Only the gases that are deflected and baffled by a series of brickwork in the combustion space are ignited; consequently a large volume of smoke is emitted. A short, white incandescent flame indicates good combustion, as the cooled gases from perfect combustion are colorless.

Where it is possible for the diffusion of gases

to be completed before combustion begins, as in the Bunsen gas burner, these difficulties naturally disappear, and there is readily attained a short flame, which, moreover, is incapable of depositing soot even on a cold object. In the case of liquid fuel, which is incapable of vaporization, the diffusion and ignition must occur simultaneously. With such a fuel there is bound to be considerable flaming, and a long tongue of flame issuing from a burner with great velocity, will, sooner or later, prove disastrous to the back sheet of the combustion chamber. Where stay-bolt nuts are exposed to the flame they should be protected by porcupines held in place by set screws, or, what is still more desirable, a lining of fire brick. The point of the flame is always the hottest, and if it impinges on a tube or back sheet it will burn it. The flame being so intense, and the circulation in that portion of the boiler so slow, a film of steam forms between the tube or sheet and prevents radiation of the metal, thereby causing overheating and bulging of the back sheet of the combustion chamber, and, in many cases, in water-tube boilers the tubes become warped and bent due to the flame impinging on the tube. Several naval vessels have had tubes burned out on their trial trips due to this cause. These ships were fitted up with oil as auxiliary to coal, as has recently been the practice in the British navy.

The process of burning oil in this way in combination with coal cannot be considered satisfactory as far as combustion is concerned. The oil is sprayed on top of the bed of coal. The opening and closing of furnace doors allows a large quantity of air to enter the furnace, cooling down the gases already in the process of diffusion below their ignition point. Also the gases being distilled from the coal suffer from the volumes of excess oxygen being admitted to the combustion space. Great danger of back flaming while working the fire causes the firemen to neglect the fires to a great extent and allows holes to be burned in the back of the furnace, allowing free air to enter without passing through the fuel bed, thereby doing no useful work, but causing a waste of fuel and energy.

Settling Tanks.

Where oil is carried in double bottoms, and required to be pumped into settling tanks, some provision should be made for getting rid of the water precipitated. A convenient and safe method is to have a hand pump on the main deck connected from the bottom of the settling tank, and discharging into a funnel and carried overboard. Then when water accumulates in the settling tank it can be pumped independent of any pump that might be on the suction line to the burners. When the water is nearly gone oil will appear in the funnel, showing that the water has been displaced, and is a sign to stop pumping. In every oil-fuel installation special provision should be made for the removal of the water that will collect from various sources at the bottom of the settling tank. Even a small amount of water pumped to the burners will interfere with the efficient and satisfactory work of an oil-fuel installation.

As it is essential with every boiler plant to secure a uniform if not large output, the annoyance and evil of occasionally pumping water rather than oil to the burners cannot be overestimated. The trained and intelligent fireman can always tell when water is present in the oil; a slight sputtering and series of short explosions gives warning; if attention is not given the oil system the fire will keep going out. The trained fireman proceeds to drain his heater and get rid of the accumulation of water precipitated caused by the heating of the oil. Therefore it is apparent that more skill and intelligence is required to burn oil than coal. Cheap and careless help around an oil-burning plant is liable to prove expensive in the end.

THE ELECTRIC SERVICE OF THE PENINSULAR TOWNS.

BY LEE H. NEWBERT.

For business reasons the vast territory served by the Pacific Gas and Electric Company is cut up into more than twenty districts. These districts are roughly somewhat larger than California counties, and, like them, they vary in shape and area according to the lay of the land and the density of the population.

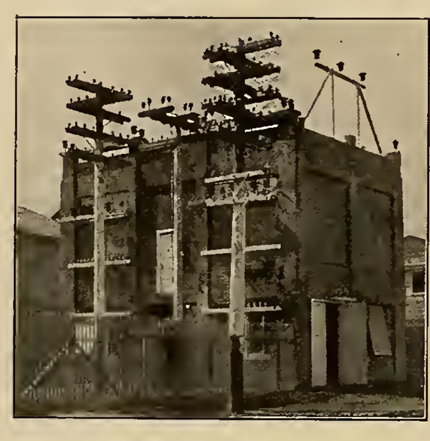
The railroad route about the southerly arm of San Francisco Bay roughly outlines a wish-bone. The joint of the wish-bone is the city of San Jose, down beyond the reach of the waters; the lobe at the end of one arm is the city of Oakland; and the lobe at the end of the other arm is the city of San Francisco. Along the peninsular arm, from the limits of San Francisco to the limits of San Jose, there is a valley and foothill stretch of territory about forty miles long and about five miles wide, gently sloping eastward toward the bay. Midway of this great suburban strip of live-oak country is Redwood, so called because half a century ago it was the center of a redwood lumber district, one old tree of which remains in the giant "Palo Alto," near Stanford University. And Redwood is the headquarters of the Redwood, or peninsular, district of the Pacific Gas and Electric Company's system. This Redwood district includes just a dozen communities: Belmont, with 600 people; Burlingame, with 5000; Easton, with 500; Mayfield, with 1500; Menlo Park, with 1500; Milbrae, with 300; Mountain View, with 2500; Palo Alto, with 6000; Redwood, with 3500; San Carlos, with 150; San Mateo, with 7000; Stanford University, with 2000; and Sunnyvale, with 2000—total, 32,500 people.

All the peninsular communities as far down as and including Palo Alto are supplied with gas manufactured at the Pacific Gas and Electric Company's great oil-gas plant in Visitacion Valley, known as Martin Station. A huge main more than twenty miles in length carries the gas supply to these communities.

But this article is chiefly concerned with the electric supply and how it is distributed. The great high-tension power-lines from the mighty hydro-electric plants up in the Sierras come down through the interior valleys and stretch high across Carquinez Straits. A southern branch extends through to Mission San Jose, and then goes on to San Jose and way down to Davenport and the city of Santa Cruz. From Mission San Jose a branch of this high-tension system comes up round the bay, through Redwood, and on into San Francisco. The pole line, with its big insulators, is a familiar sight across the marsh lands.

At Redwood there is an electric station. It serves two functions: It is the distributing station for sup-

plying the electric needs of the northern part of the peninsular district, and it is an important high-tension switching station. The second floor of the concrete building is devoted exclusively to high-tension wiring and switching. That long marsh land pole line carries two 60,000-volt lines from Mission San Jose round into San Francisco, and those two lines pass through the Redwood station, where the switching arrangement is such that either of the two lines coming into or going



The Station at Redwood

out of the station can be taken out of service temporarily to permit repairs or work on them without shutting off the current along the entire double line. The different high-voltage switches making this safety plan possible are placed in separate concrete compartments, the construction of which, like that of the entire building, is intended to reduce fire risk to the smallest possible factor.

When what is now the Pacific Gas and Electric Company came into possession, about eight years ago, of the gas and electric properties of the peninsula, the sub-station at Redwood consisted of a wooden-frame building, covered with corrugated iron. It was 20 ft. square and 24 ft. high. For equipment that building had simply four 200-kw., high-tension transformers (one being a spare held in reserve) and three high-tension Stanley air-switches. The 6000-volt secondaries were carried overhead to another frame and corrugated-iron structure housing a steam auxiliary plant and a secondary switchboard, which was a combination of marble, wood, open fuses and air-brake switches.

By 1906 business along the peninsula had so increased that the present two-story concrete station building at Redwood was ordered erected. It is 26 by 36 ft. and stands 28 ft. high. The high tension oil and disconnecting switches in the enclosed concrete compartments on the upper floor are operated from the lower floor by means of levers. And on the lower floor are the high-tension transformers, the switchboards, the regulators and other apparatus.

There are three 500-kw. transformers. They reduce the main-line current to 11,000 volts for transmission northward to San Mateo and other towns and southward to Palo Alto, Mountain View and Sunnyvale; and to 4000 volts for local distribution in Redwood and the vicinity. There are also three 100-kw. transformers to supply Redwood's local service. These smaller transformers are fed from the 11,000-volt lines coming from the high-tension transformers. The connection is such that if anything should happen to the Redwood station these smaller transformers for Redwood's local service could be instantly supplied through the 11,000-volt line from the Mountain View station. The 11,000-volt circuits are three-phase, and the local distributing circuits are three-phase, four-wire, 4000-volt.

Ordinarily the current all comes from the hydro-electric plants in the distant Sierras through either of the two three-phase 60,000-volt lines, which extend on to San Francisco. But if something should happen along the hydro-electric power line there is an emergency switching arrangement by which current may be turned on from the company's great steam-generating electric plant situated out beyond the Union Iron Works in San Francisco, or from the company's steam-generating electric plant at San Jose. So the peninsular towns cannot be deprived of electricity except through some rare combination of accidents putting several mountain and two city plants temporarily out of commission.

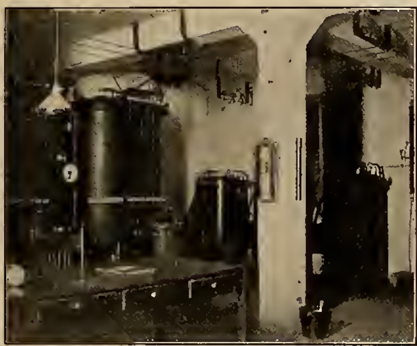
The growth of peninsular population following the San Francisco fire was rapid, and early in 1907 it became evident that the existing electric system of the United Gas and Electric Company (a subsidiary company of the Pacific Gas and Electric Company) would have to be completely reconstructed in order to meet the increased demand for light and power service. Briefly described, the system to be replaced consisted of a main high-tension sub-station at Redwood, with two-phase, 6000-volt lines extending southward fourteen miles to Sunnyvale and northward eight miles to San Mateo. At San Mateo two 100-kw. transformers were employed to reduce the pressure to 2200 volts for distribution to San Mateo and Burlingame.

The 4000-volt distributing switchboard, the oil switches being mounted on the left. At the left are the high tension levers.

After a thorough study of conditions it was determined, notwithstanding the existing high price of materials, to rebuild in such a manner as to give not only a greatly improved service, but also to meet requirements for some time into the future. Subsequent development in the peninsular towns has demonstrated that the decision was a wise one, as the electric load taken to-day exceeds that of 1906 by one hundred per cent.

The new peninsular system as laid out by the engineering department called for an additional high-tension station at Mountain View, eleven miles south of the existing station at Redwood. The Mountain View station was to be fed from the high-tension line then in course of construction and now supplying

Davenport and Santa Cruz. There was to be a secondary sub-station at Palo Alto and an enlargement of the secondary sub-station at San Mateo. These stations were to be connected by a three-phase, 11000-volt tie line, with current supply from either Redwood or Mountain View.



Two of the three 100-kilowatt transformers that supply the local service.

As a result of the work, which was completed in the summer of 1908, the system consists to-day of the high-tension station at Mountain View, which, under regular operating conditions, supplies service to Mountain View and Sunnyvale and to the Palo Alto sub-station; and of the high-tension station at Redwood, which supplies Redwood and the San Mateo sub-station. The switching arrangement is such that, when circumstances require, either the high-tension station at Redwood or the one at Mountain View can supply the entire peninsular district.

The Mountain View station contains three 500-kw. oil-insulated, water-cooled, single-phase transformers, star-connected for 60,000 to 11,000 and 4000 volts; three 100-kw., single-phase, oil-insulated, air-cooled transformers; and the necessary switchboard and control apparatus. The high-tension oil-switches, like those at Redwood, are located on the second floor. The disconnecting switches are pole type, and are located on suitable structures outside. Voltage regulation is by hand, with two sets of regulators, one on the secondaries of the high-tension transformers and the other on the secondaries of the low-tension, or 4000-volt, transformers.

Service to Sunnyvale, three miles south of Mountain View, is through a three-phase, four-wire, 11,000-volt line. Mountain View service is three-phase, four-wire, and is regularly supplied from the 4000-volt transformers. When necessary, this service may be supplied from the 4000-volt taps of the high-tension transformers. Service transformers have voltages of 2400 to 220 or 110.

The Palo Alto sub-station is supplied through a three-phase, four-wire line. Service transformers are connected to supply consumers along the seven-mile line between Mountain View and Palo Alto. The Palo Alto sub-station contains three 250-kw., oil-insulated, single-phase transformers, 11,000 to 2400 volts; and the necessary switchboard, control apparatus and instruments. Voltage regulation is by means of two single-phase, automatic induction regulators so connected as to maintain a maximum voltage during the peak of the load. The secondary circuits are: Stanford University, Peninsular Railway, Palo Alto single-phase (for commercial district), Palo Alto polyphase (for residence service), power, Menlo three-phase.

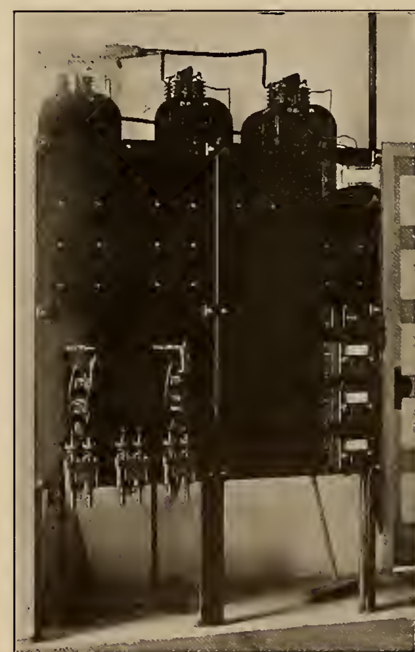
An 11,000-volt, three-phase, No. 4 copper, three-wire circuit extends from the Redwood station to the Palo Alto sub-station, four miles south, where it can be joined to the 11,000-volt line from the Mountain View station, when operating conditions require. Another 11,000-volt, three-phase, No. 4 copper, three-wire circuit extends from Redwood north eight miles to the San Mateo sub-station.

The local circuits from Redwood station are: Redwood lighting (single-phase, 4000 volts), Redwood power (three-phase, four-wire, 4000 volts), San Carlos and Belmont (three-phase, four-wire, 4000 volts), Fair Oaks (single-phase, 4000 volts), street lights.

The San Mateo sub-station contains three single-phase, 300-kw., oil-insulated, air-cooled transformers, 11,000 to 2400 volts, together with the necessary switchboard and control apparatus. Voltage regulation is by means of two single-phase, automatic induction regulators. The secondary circuits are: San Mateo single-phase (2400-volt for commercial district lighting), San Mateo poly-phase (for residence district), Homestead poly-phase, water works poly-phase, Peninsular Hotel poly-phase, Burlingame poly-phase, San Mateo street lights, Burlingame street lights.

In addition to the regular telephone service a private telephone line connects the stations at Redwood, Mountain View, San Mateo and Palo Alto.

All switching on the 11,000-volt line is directed by the Redwood station.



The 11,000-volt Switchboard (oil switches are in concrete compartments at the left).

The current supply to both high-tension stations is through duplicate lines from the Sierra power houses or (through the same lines) from the steam plants at San Francisco and San Jose. With the aid of the 11,000-volt tie line in case of accident at either high-tension station interruptions in service are doubly provided against, and the rare occasions when they do occur they last but a few moments.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
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604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Measuring Instruments

The present hue and cry against defrauding the government with "fixed" sugar scales and cheating the ignorant poor by means of false weights and measures are popular manifestations of a general demand for precision. This insistence upon accuracy pervades every branch of business and is the fundamental requirement of all scientific work. Exactitude is fast superseding guess work and the definite formula is displacing the rule of thumb. To meet commercial requirements of rapid correctness there have been devised many ingenious instruments, such as the adding machine, computing scale, and cash register, which substitute mechanical for mental calculation. But, as science was the first to demand accurate measurement, so it has been the first to be supplied, and we now find many scientific instruments of precision being adopted for industrial uses.

Of these perhaps the most noteworthy is the adaptation of the laboratory galvanometer to the measurement of electric power. The watthour meter regulates the financial relations between the producer and the consumer and upon its integrity depends much of that desirable confidence which exists between the public and the corporation that serves it. Similar principles underlie many of the various switchboard instruments which control the operation of power plants. These include ammeters, volt-meters, both indicating and recording, together with frequency meters, power factor meters and synchroscopes.

For the laboratory, also, many new electrical instruments have lately been perfected with a range or a delicacy so great that it is now possible to measure phenomena which but a few years ago was difficult of even mental conception. Of such is the oscillograph, which give visible confirmation of the theory of alternating currents; also Professor Ryan's corona voltmeter and cathode ray indicator for observing high tension behaviors. Of equal value is the newly perfected megger for measuring insulation resistance, as described elsewhere in these columns.

Steam power plant economy has long required careful measurement of in-going fuel, air and water, and of out-coming power and waste, but it is only recently that these have been automatically determined by recording instruments from which the plant efficiency may be computed. Coal is delivered through an automatic weigher and oil is supplied, like air and water, through a recording meter. The amount of the flue gases, as well as their content, may be continually recorded for comparison with the weight of ash. A gauge tells of the maintenance of steam pressure and the recently perfected steam flow meter not only shows whether a boiler is delivering the proper amount of steam, but also indicates any leaks between the boiler and the engine, the performance of the latter being in turn checked by the indicator.

Many other examples could be quoted to show the increased industrial uses of measuring instruments, but enough has been said to indicate the trend of this movement, which will soon eliminate many of the old cut and try methods and make possible that accuracy which leads to true economy.

PERSONALS.

A. W. Fulton, an electrical engineer of Chicago, was a recent San Francisco visitor.

C. R. Downs of the water and lighting company at Sutter Creek, was at San Francisco last week.

H. B. Woodhill, of the Woodhill-Hulse Electric Company of Los Angeles, is visiting at San Francisco.

T. Meyers, an electrical engineer from the Island of Java, was a recent arrival at San Francisco.

W. P. Thomas, president of the Snow Mountain Power Company, was at San Francisco from Ukiah last week.

C. H. Coulter has succeeded H. P. Pitts, resigned, as purchasing agent for the Great Western Power Company.

E. B. Spalding, of Spalding, Sloan & Robson, San Francisco, has gone to Newman on electrical construction work.

W. B. Cline, president of the Los Angeles Gas and Electric Company, spent several days at San Francisco last week.

C. L. Cory has recently been successful in adapting electric motors to the requirements of the oil operators in the Bakersfield district.

F. A. Cressey, president and manager of the Modesto Gas Light, Coal and Coke Company of Modesto, recently spent a day at San Francisco.

D. B. Dean, representing the Kuhlman Car Company, after visiting Pierson, Roeding & Co. of San Francisco, left last Thursday for the Pacific Northwest.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, returned to San Francisco this week after a successful trip throughout the Pacific Northwest.

William Spalding, formerly with the Portland Railway, Light and Power Company, is now general manager of the Tillamook Electric Light and Fuel Company of Tillamook, Oregon.

James D. Schuyler, a hydraulic engineer of Southern California, who has been making engineering investigations in foreign countries for several years past, has arrived at San Francisco from Budapest.

Frank B. Hall, of Wheeling, West Virginia, and C. H. Judson are making an examination of the plant valuations and rates of the two telephone companies operating in Seattle for the Department of Public Utilities of that city.

M. de Chatelain, professor of the Polytechnic Institute and president of the Russian Imperial Technical Society, of St. Petersburg, recently spent a few days at San Francisco on a tour of the Pacific Coast, including a visit to the largest hydro-electric plants.

Hugh McPhee, formerly chief dispatcher and chief division operator of the Eastern and Kansas City division of the Western Union Telegraph Company, with headquarters at Emporia, Kansas, has been made manager of the main and branch offices of San Francisco, succeeding J. V. O'Brien.

John V. O'Brien, for years manager of the San Francisco city offices of the Western Union Telegraph Company, has been appointed special agent for the company for its First District, a territory comprising Northern California, Nevada and a portion of Arizona. He will have charge of the commercial business of the company under District Superintendent May.

Leon M. Hall, of San Francisco, has resigned as consulting engineer of the Comstock Pumping Association, after eleven years of faithful service. He had charge of the designing and installation of the famous electric pumping stations in the depths of the Comstock mines under conditions that required great skill and daring. Excellent showings were made as to efficiency. Major George Burbank, who represents the Probst-Wetzler banking interests behind the new United Comstock Pumping Association, has arrived at Virginia City as Mr. Hall's successor.

MEETING OF PACIFIC COAST GAS ASSOCIATION.

ORGANIZED PACIFIC COAST GAS ASSOCIATION JULY 11TH 1893

The eighteenth annual convention of the Pacific Coast Gas Association will be held at Los Angeles, California, September 20, 21 and 22, 1910, meetings being held in Choral Hall, Auditorium Bldg., Fifth and Olive streets.

The following papers will be read before the meeting: President's address, W. B. Cline; "Progress in Oil Gas Manufacture," J. M. Berkley; "Work Economies," Sherwood Crover; "The Municipal Inspection of Gas and Meters," Wm. Schade; "Gas Leakage," Geo. Kirk; "Relations With the Public," R. H. Ballard; "Necessities for a Public Service Commission in California," John A. Britton; "General Policy Regarding Pipe Extensions," C. A. Luckenbach; "Prevention of Accidents," J. P. Coghlan; "The Oil Situation From the Gas Man's View Point," H. W. Burkhart; "Suburban Distribution," L. H. Newbert; "The Introduction of the Gas Furnace," Charles F. Stamps, Jr.; "Fire Insurance and Protection," R. J. Cantrell; "The Chemical Control of Gas Works," E. L. Hall; "Wrinkles," Wm. Schade; "Experiences," Leon B. Jones.

Arrangements have been made with the Southern Pacific Company, the Santa Fe Company and the Salt Lake Company whereby the members attending the convention will be given a rate of one and one-third fare for the round trip (receipt certificate plan), and which plan will be in force for the period from September 10th to October 2d for all members attending the convention from points north of Mojave and Santa Barbara. Members attending from Mojave and Santa Barbara and points south thereof will have their certificates honored for return trip tickets up to and including September 26th.

The banquet will be held in the Hotel Alexandria on Wednesday evening, September 21st, at 8:00 o'clock.

Entertainments have been arranged as follows:

Thursday, September 22d, will be known as "Southern California Edison Company Day." At 9:00 o'clock a. m. the Edison Company will take the members of the association and their friends on an excursion to Soldiers' Home, Santa Monica, Ocean Park, Venice and Redondo. At Redondo luncheon will be served at 12:00 o'clock noon. Dancing, bathing and other entertainments during the afternoon. Returning to Los Angeles at 5:00 o'clock p. m.

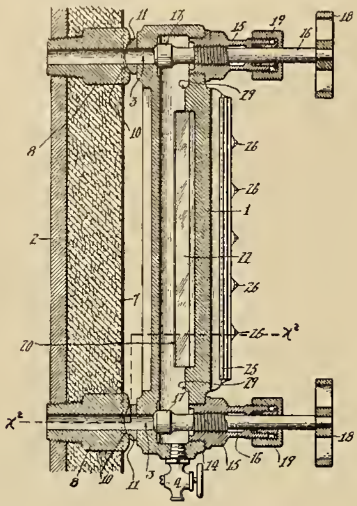
Friday, September 23d, will be known as "Domestic Gas Company Day." At 9:00 o'clock a. m. the Domestic Gas Company will take the members of the association and their friends on an excursion to Mount Lowe, where luncheon will be served at noon. Returning to Altadena at 2:00 o'clock p. m., automobiles will meet them for a trip through Altadena, Pasadena, South Pasadena, Alhambra, Eagle Rock Valley to Casa Verdugo (where light refreshments will be served), thence to Glendale, Tropico, Hollywood and Los Angeles.

Saturday, September 24th, will be known as "Los Angeles Gas and Electric Corporation Day." The Los Angeles Gas and Electric Corporation will take the members and their friends on an excursion through Watts, Compton and Wilmington to San Pedro, at which point steamer will be boarded for Catalina Island. Lunch will be served at noon at the Hotel Metropole, in Avalon.

It has been decided by the directors of the association to give an Appliance Exhibition. The Central Park Skating Rink, at No. 416 West Sixth street, has been secured for this purpose. Up to the present time more than twenty of the large manufacturers of appliances have signified their intention of taking space in this hall for the exhibition of their appliances. This exhibition will be open to all members and their friends, as well as the general public.

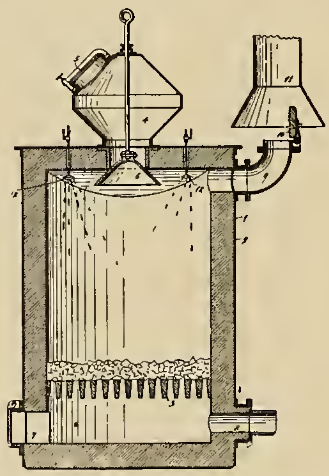
PATENTS

967,634. Water-Gage. George H. Goodwin, Los Angeles, Cal. In a duplex water gage, the combination with a jacketed boiler, of two hollow nipples therein, the outer end of each of which is provided with a seat, an elongated hollow body provided with two elongated sight openings set at an angle



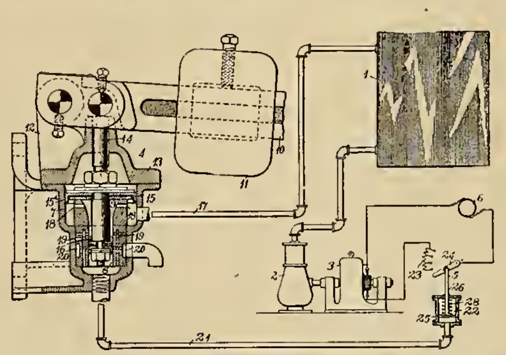
to each other and provided with a passage and perforated ears at each end, valve mechanism for controlling said passages, a perforated joint ring between each seat and a corresponding end of the body, and bolts through said ears and said jacket into the head of the boiler.

967,213. Process of Making Producer-Gas. Leon P. Lowe, San Francisco, Cal. The process of making producer gas which consists in passing air through an ignited bed of solid fuel to heat the same to incandencence and then passing oil and air into and through said incandescent bed in



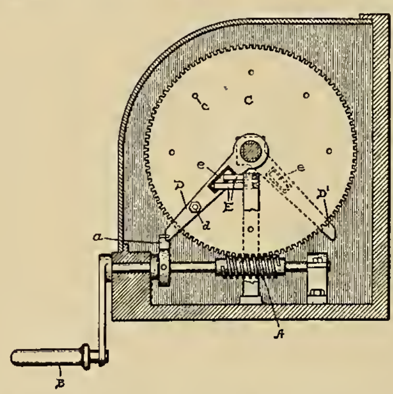
a downward direction, to, first, disassociate the oil into gases and heavy hydro-carbons, and then to convert the heavy hydro-carbons into gases and solid carbons, the latter combining with the air to maintain the proper temperature and assist in forming the producer gas ln the usual manner.

967,234. Fluid-Pressure Regulator. Thomas S. Pufferud, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. The combination with a fluid-pressure tank or chamber, a fluid-pumping mechanism connected thereto, a driving motor for said pumping mechanism, a starting controller for the motor, and an operating cylinder and piston, of a regulator for automatically admitting fluid-pressure to and exhausting it from the operating cylinder to respectively start and stop the motor as the pressure in the storage tank or chamber rises above and falls below a pre-



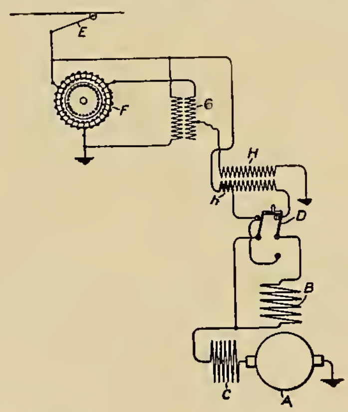
determined value, and means for compensating for the variations in the friction of the regulator.

967,171. Low-Speed Circuit-Controller. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. A low speed circuit controller comprising a worm, a worm wheel adapted to be driven in either direction by said worm, two sets of stationary contacts, and two members carried by the



wheel serving as stops to limit the movement of the wheel in opposite directions and to engage the two sets of contacts respectively when the wheel reaches the two limits of its range of movement, said two members being relatively adjustable to vary the range of movement of said wheel.

967,295. Braking Alternating-Current Motors. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The method of braking an alternating current motor of the commutator type which consists in



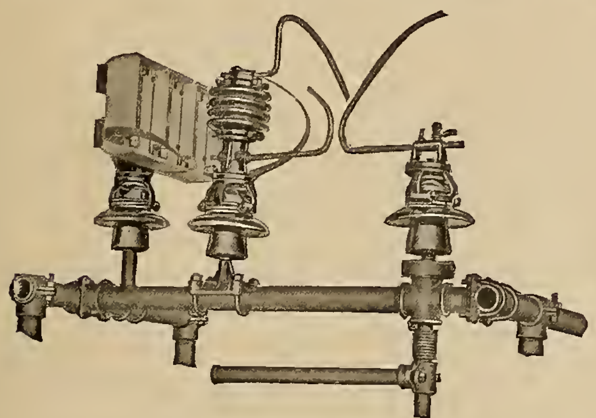
connecting the armature to the source and impressing on the field of the motor a voltage displaced in phase substantially ninety degrees from the voltage of the source and controlling the phase of said impressed voltage to vary the braking effect.

INDUSTRIAL

ALUMINUM LIGHTNING ARRESTERS FOR UNDERGROUND CABLES.

One of the most serious problems with which operators of underground cable systems have to contend is the protection of the cables against internal surges and against lightning in cases where the underground circuits are connected to overhead lines. During the past two years the General Electric aluminum arrester has been given a wide application in the protection of cable and mixed overhead and cable circuits, in fact has practically superseded all other forms and with its recent improvements is still better adapted for this class of service.

One characteristic of the aluminum arrester which has an important bearing on this application is the daily charging of the cells—a process which consists simply of subjecting the stacks of aluminum cones to the line voltage and short-circuiting the series horn gaps for a brief period. This charging process as well as normal discharges resulting from high voltage disturbances is accompanied by a slight arcing at



Aluminum Lightning Arrester.

the horn gaps. On cable systems where the electro-static capacity is large compared with the inductance of the circuit, it is advisable to take every possible precaution to limit the charging current to a minimum value.

In the General Electric aluminum arrester this is accomplished by means of a special horn gap used in connection with a charging resistance. The resistance limits the charging current and even if the cells are in poor condition smooths out the wave shape of the current and damps out any tendencies to oscillate. At the same time it does not prevent the cells from taking their full charge. These auxiliaries are so arranged as to give selective paths to the cells; one through a horn gap without resistance, which is the same as in the arresters for overhead circuits, and the other through a resistance and a horn gap, the setting of which is slightly less than that of the gap resistance. With this arrangement the daily charging current and the average surge discharge take the path through the resistance. This resistance is adjusted to a value which will so modify the nature of the charging arcs that there is no liability of resonance occurring. It also makes the charging more uniform and reliable.

Heavy discharges which will be impeded somewhat by the resistance will be shunted through the principal horn gap and have a free path without resistance. The arc from this discharge, rising on the horns, will be intercepted by the blade which is connected to the resistance and hence the current is limited at the end of the discharge and as the arc breaks. Thus surging which would be produced by the breaking of a large current arc in air is entirely elimiated by having the arc and current suppressed. Thus the safety horn gap with the charging resistance combines a number of valuable features in safety of operation without in any way decreasing the efficiency of the arrester as a protector of cable systems.

TWO TO THREE-PHASE TRANSFORMATION WITH STANDARD TRANSFORMERS.

It is frequently desirable to operate three-phase motors from a two-phase circuit. Almost any handbook or textbook will tell you that this may be done by using Scott transformation. The book will proceed to tell you that it is necessary to have the "three-phase coils of one transformer designed for 100 volts while the three-phase coils of the other transformer must be designed for 86.6 volts, or in that ratio." Such information is of but little value when a three-phase motor must be connected to a two-phase circuit, and connected in a hurry.

The accompaning diagram shows a connection which has been made frequently with standard Hawthorn transformers.

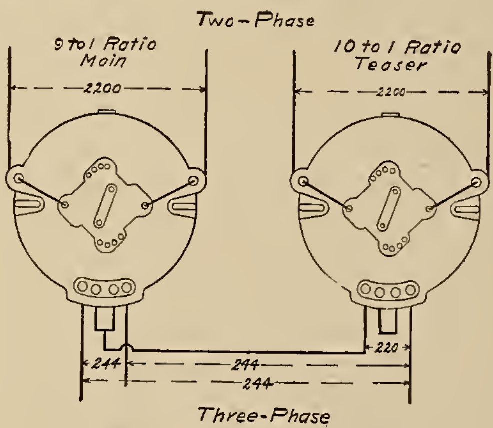


Diagram of Transformer Connections.

A 1100-2200 volt primary, 122-244 volt secondary, (ratio 9:1) transformer connected as "main" with a 1100-2200 volt primary, 110-220 volt secondary, (ratio 10:1) transformer connected as "teaser" may be recommended to operate a 220-volt three-phase motor on a 2200-volt two-phase supply. The secondary voltage given by this arrangement is 244 volts three-phase, but, allowing for line drop, etc., it is a satisfactory voltage on which to operate 220-volt motors. The unbalance and increase in heating are so small as to be negligible.

The Western Electric Company's Hawthorn transformers are well-suited to this work, the four secondary leads which are brought out on all of them, in order to make possible either of two secondary voltage connections, are a great convenience in making the two-phase to three-phase connections.

TRADE NOTES.

The F. B. Kellogg Switchboard & Supply Company have closed a contract for a switchboard at Grand View, Wash. in connection with the Benton Independent Telephone Company of Prosser, Wash. It is heing engineered by Harry Miles at Prosser.

The Mexican-Northwestern Railway Company of 25 Broad Street, New York City, has recently placed a large order for motors with Westinghouse Electric & Manufacturing Company. The order includes 168 induction motors, aggregating 3736 h.p., of the types MS and HF, ranging from 3 to 200 h.p. These motors will be shipped to the company's property at Madera, Chihuahua, Mexico, to be used in the operation of the saw and planing mills.

APPROVED ELECTRICAL DEVICES

CABINETS.

Sheet Metal. Types J and K, also sectional Types G and H. Cast Iron. Type A. Approved Aug. 11, 1910. Manufactured by

H. T. Paiste Company, 32nd and Arch Sts., Philadelphia, Pa.

CONDUIT BOXES.

"Pipe-End" fittings, Cat. Nos. 1201-1204 incl., 1251 and 1252, with steel or porcelain covers. Approved, only for exposed work, July 1, 1910. Manufactured by

Arrow Electric Company, 630 Capitol Ave., Hartford, Conn.

"Pipe Taplets." Cast iron outlet boxes with threaded opening for standard sizes of rigid conduits. Types A, B, C, E, LL, LR, T, U and X. Also Cat. Nos. 4115, 4125, 4135 and 4170 for use with special porcelain covers or with suitable approved rosettes or receptacles. Approved, for exposed work only, July 20, 1910. Manufactured by

H. T. Paiste Company, 32d and Arch Sts., Philadelphia, Pa.

CONDUIT, MISCELLANEOUS.

Indurated Fibre Conduit. Approved, for use only in central stations and when laid in concrete for its entire length, July 18, 1910. Manufactured by

United Indurated Fibre Co. of New York, Lockport, N. Y.

CONDUIT OUTLET BUSHING.

"Burns" Entrance Hoods. Cat. Nos. 801-807 inclusive. "Burns" Terminal Fittings of the type of Cat. No. 911, etc., for conduit from ½ in. to 4 in. Approved July 22, 1910. Manufactured by

James F. Burns, 47 N. Hutchinson St., Philadelphia, Pa.

FLEXIBLE CORD, PORTABLE, FOR ELECTRIC HEATERS.

Double conductor cord. Stranded conductors with rubber and asbestos coverings. One type having single protecting braid over parallel pair of conductors; another type having single protecting braid over each of a twisted pair of conductors, and a third type having protecting braid on each conductor and a second protecting braid over the twisted pair of conductors. Marking: Yellow thread in cotton wind around copper strands. Approved August 8, 1910. Manufactured by

Safety Insulated Wire & Cable Co., 114 Liberty St., New York, N. Y.

GROUND CLAMPS.

A malleable cast iron fitting marked "T" for grounding gas pipe in conduit outlet boxes. Sizes for ⅜ inch and ½ inch pipes. Approved July 30, 1910. Manufactured by

Thomas & Betts Company, 299 Broadway, New York, N. Y.

HANGERBOARDS, ARC LAMPS.

"Perkins." Cat. Nos. 3221, 3226 (with plug fuse receptacles) and 3269 (with double pole ceiling switch and plug fuse receptacles). The switches are approved and labeled under the conditions previously stated. Approved July 20, 1910. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

HEATERS, ELECTRIC.

"Johns-Manville" cylindrical heaters. Special Type H No. 1. Cat. No. 1566 for 110 volts. Cat. No. 1567 for 220 volts. A group of heat coils encased with perforated sheet metal and supported on iron legs. Supplied with regulating switch and approved heater cord for portables, for use on circuits up to 5,000 watts. Approved, when installed for use with suitable supply circuit, July 25, 1910. Manufactured by

H. W. Johns-Manville Co., 100 William St., New York, N. Y.

INSULATING SUPPORTS.

Glazed porcelain insulating knobs for supporting twisted pair telephone wires outside buildings and on poles. Cat. Nos. 1001, 1002, 1003. Approved, for outside work for wires of signaling system, July 20, 1910. Manufactured by

Universal Specialty Company, 120 South Seventh St., Terre Haute, Ind.

MISCELLANEOUS.

Consolidated Buzzer System for use on electric cars or in power houses and car shops operating on 600 volt circuits, consisting of a fuse, resistance coil, interrupter and buzzers in series with a multiple series of push buttons. Approved, only when installed in compliance with requirements for car wiring or constant potential systems, and with push buttons in which the contacts are mounted upon bases of insulating fire resisting material, July 20, 1910. Manufactured by

Consolidated Car-Heating Company, Fisher Bldg., Chicago, Ill.

RECEPTACLES, FOR ATTACHMENT PLUGS.

"Arrow E" 12 A. 250 V. Flush Receptacle. Cat. No. 1062 with attaching plug 1065. Approved July 6, 1910. Manufactured by

Arrow Electric Company, 630 Capitol Ave., Hartford, Conn.

Hubbell" Flush Receptacles. Cat. Nos. 5498 and 5547, with plugs 5419-5421, inclusive, and Cat. No. 5566, with plug 5567, 10 A., 250 V. Cat. No. 5552; 20 A., 250 V., with plug 5553. Approved August 8, 1910. Manufactured by

Harvey Hubbell, Inc., Bridgeport, Conn.

"Hubbell" Surface Receptacles. Cat. Nos. 5617-5620, inclusive, 10 A., 250 V., with plugs 5419-5421 inclusive. Cat. Nos. 5621-5623, inclusive, 20 A., 250 V., with plug 5553. Conduit box types, Cat. Nos. 5614 and 5624, 10 A., 250 V., with plugs 5419-5421, inclusive. Cleat, concealed and moulding types, Cat. Nos. 5558, 5557 and 5559, respectively, 20 A., 250 V., with plug 5553. Approved August 8, 1910. Manufactured by

Harvey Hubbell, Inc., Bridgeport, Conn.

RECEPTACLES, STANDARD.

"Bryant" 660 W., 250 V. Sign, Cat. Nos. 1700, 4003, 40488, 46749 and 59108. Also 4014 ("Ruby" 102717) when installed so that both the porcelain base and metal rings are held by means of solder so that they cannot turn in the sign face. Cleat, Cat. Nos. 921, 1011, 1123, 4013, 9402, 9403, 11221, 28795, 50715, 58300, 58301, 58949. Concealed, Cat. Nos. 4000-4002, inclusive, 50744, also 9447, fusible, 2 A., 125 V. Moulding, Cat. Nos. 42453, 58302 and 58950. Conduit Box, Cat. Nos. 4003, 9397, 9514, 40507, 40537,59107, 62355, 62356 and 62357. Approved August 13, 1910. Manufactured by

Bryant Electric Company, Bridgeport, Conn.

"H. T. P. Co.," 660 W., 250 V. Sign Receptacles, Cat. Nos. 1700, 40488, 46749 and "Russell" 59439. Cleat Receptacles, Cat. Nos. 9402, 9403, 11221, 50715, and Fielding 23209, 23210. Concealed Receptacles, Cat. No. 50744. Moulding Receptacles (two-wire), Cat. Nos. 47567, 47568, Fielding 50724, 50726, also (three-wire) Fielding 36519. Conduit Box Receptacles, Cat. Nos. 9397, 40507 and "Russell" 47566. Condulet Receptacles, Cat. Nos. 46555, 47696. Approved August 11, 1910. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

"P. & S.," 3 A., 250 V. Cleat, Cat. Nos. 61870 (870), 61871 (871), 64369 (821), and 66612 (822). Moulding, Cat. Nos. 61670 (670), 61770 (770), and 100136. Sign or Conduit Box Type, Cat. Nos. 975, 61072 (1072), 61777 (777), 61973 (973), and 61977 (977). Removable ring types, Cat. Nos. 61577 (577),

61578 (578), 61877 (877), 61988 (988), 102703 and 102704. Also 61900 (900), for use only in borders of double faced metal panel signs, and 61960 ready wired for sign work with receptacles spaced 4 inches on centers. This receptacle is also furnished wired with No. 12 or No. 14 wire and with spacings 5-30 inches on centers. Condulet Receptacle, Cat. No. 88259. Conduit Box Type, Cat. Nos. 9514, 50717, 62357, 103704 and 104603. Approved August 11, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

"Marshall," 3 A., 250 V. Cleat Type, Cat. No. 44954. Approved July 11, 1910. Manufactured by

Marshall Electric Company, Hartford, Conn.

"G. E.," key and keyless types. Wall Sockets, brass shell. Key, Cat. Nos. 9184, 27742, 28721 (slotted or closed base), 29404, 29406, 50753 (slotted or closed base), and 60018, also 88959 (for use on metal ceilings). Keyless, Cat. Nos. 9185, 27743, 28722, 29405, 29407, 50755, 60019 and 60020, also 88960 (for use on metal ceilings). Porcelain Shell, keyless, 3 A., 250 V. Cleat type, Cat. Nos. 11221, 28794, 28795, 50715, 59275 and 61039. Concealed type, Cat. Nos. 49355, 50717, 50744. Also 50752, fused, 2 A., 125 V. Moulding types, Cat. Nos. 34152, 58303 and 100266. Conduit Box, Cat. Nos. 9397, 9514, 40537, 49354, 60931 and 62357. Sign Receptacle, Cat. Nos. 46627 and 105000. Approved July 22, 1910. Manufactured by

General Electric Company, Schenectady, N. Y.

RECEPTACLES, WEATHERPROOF.

"Paiste," 660 W., 600 V. Porcelain base receptacles, Cat. Nos. 9407, 9408, 9411 and 44912. Approved, for use with incandescent lamps in series on 600 volts circuits, August 11, 1910. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

"Paiste," 660 W., 250 V. Porcelain base cleat receptacle. Cat. No. 59275. Approved August 13, 1910. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

RHEOSTATS.

"G. E.," all capacities, 125-500 volts. Motor starters CR-107 and CR-109 (Type SA). Motor starters with field control, CR-162 (Type SFA). Speed regulating continuous duty, CR-151-154, inclusive, (Type RA). Printing press control, CR-170 and 170-A, CR-171 and 171-A (Type PB). Field Rheostats, CR-174 (Type F). Field Rheostats, sprocket driven, CR-178 (Type F). Field Rheostats, electrically operated, CR-179 (Type F). Also CR-111, CR-163 and CR-155 to 158, inclusive (Types SO, RO and SFO, respectively), with overload release devices which are inoperative during process of starting motor. Approved only when other circuit breakers or fuses are installed in connection with them. See N. E. Code Rule 60-g. Approved August 8, 1910. Manufactured by

General Electric Company, Schenectady, N. Y.

ROSETTES, FUSELESS.

"H. T. P. Co.," 3 A., 250 V. Cleat, Cat. Nos. 433, 434, 480 also 463, with sub-base 464. Concealed, Cat. Nos. 441 and 481. Moulding, Cat. Nos. 435 to 438, inclusive, and 482. Approved August 11, 1910. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

SIGN MACHINES.

Single pole, single break, capacity 3 to 15 A. per switch, 110 volts. Single pole, double break, capacity 10 to 50 A. per switch, 110 volts. Single pole, script writing, capacity 1 A. per switch, 110 volts. Double pole, double break, capacity 20 to 50 A. per switch, 220 volts. Triple pole, double break, capacity 20 to 50 A. per switch, 110-220 volts. Approved, only when provided with cabinets complying with the requirements of the National Electrical Code, and when wired and installed in a manner satisfactory to inspection department having jurisdiction, July 11, 1910. Manufactured by

Electric Carriage Call & Specialty Co., 173 Christopher St., New York, N. Y.

SOCKETS, MINIATURE.

Miniature and Candelabra Socket, 75 W., 125 V. Pendant, Cat. Nos. 322 and 323. Brass Shell, Keyless, Cat. Nos. 320, 321, Pull, Cat. No. 386. Candle Sockets, Cat. Nos. 327, 328, 346 and 347 for use only in connection with porcelain candle. Approved August 11, 1910. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

SOCKETS, WEATHERPROOF.

"P. & S.," 3 A., 250 V. Composition shall, Cat. Nos. 43310 and 60666. Porcelain shell, Cat. Nos. 9366 (116), 9448 (0116½) and 9496 (116½). Also 61418 (418) for festoon work, and 61420, ready wired for decorative work with sockets spaced 4 inches on centers and with insulated suspension cleat and hook, Cat. No. 430. This socket is also furnished wired with No. 12 or No. 14 wire and with spacings 5-30 inches on centers. Approved August 13, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

SWITCHES, COMBINATION CUTOUT.

"Perkins," 10 A., 125 V. Double pole snap switches combined with Edison plug cutouts. Cat. Nos. 2300, 2360 and 2400. The switches are approved and labeled under the conditions stated on card 1464 A. dated April 15, 1910, filed Switches Surface Snap. Approved July 20, 1910. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SWITCHES, KNIFE.

"Barkelew" motor starting switches, for use with A. C. motors of not over 5 h.p. Spring-controlled double-throw knife switches equipped with cutouts for N. E. Code cartridge enclosed fuses. Fuses are in circuit only when switch is in running position. Type L, 2 and 3-phase, 30 A., 250 and 500 V. Approved July 6, 1910. Manufactured by

Barkelew Electric Mfg. Co., Middletown, Ohio.

SWITCHES, PUSH BUTTON FLUSH.

Diamond H. Single pole, 5 A., 250 V., 10 A., 125 V., Cat. Nos. 10 and 050. Double pole, 10 A., 250 V., Cat. Nos. 20 and 060. 3-way, 5 A., 250 V., 10 A., 125 V., Cat. Nos. 30 and 070. 4-way, 5 A., 250 V., 10 A., 125 V., Cat. No. 40. Also above types with lock attachment. Approved August 8, 1910. Manufactured by

Hart Mfg. Co., 103 Allyn St., Hartford, Conn.

SWITCH BOXES.

"S. E. Co." For flexible steel conduit, Cat. Nos. 5950, 6965, 6966, 6971-6978, inclusive. For steel armored cable, Cat. Nos. 5951, 6960, 6961, 6991-6998, inclusive. For rigid conduit, Cat. Nos. 3001-3006, inclusive, lined of unlined. Approved July 25, 1910. Manufactured by

Sprague Electric Co., 527 West 34th St., New York, N. Y.

TRANSFORMERS.

Air cooled transformer for outdoor use. Type SL, primary voltage 110 to 220, secondary voltage 10 to 20, capacity 1000 watts. Approved, only when installed and wired in both primary and secondary circuits in accordance with Class C wiring National Electrical Code, August 11, 1910. Manufactured by

Duncan Electric Mfg. Co., LaFayette, Ind.

"Beacon" transformer for use on 104-120 volt A. C. circuits. Type X delivering current on secondary side at 6, 12 and 18 volts. Approved, only for ringing bells and for similar signaling work and when primary wiring is installed in accordance with Class C of the National Electrical Code, July 18, 1910. Manufactured by

Electric Economy Co., 64 Warren St., Roxbury, Mass.

TUBING, FLEXIBLE.

Approved July 11, 1910. Manufactured by

Conduit & Cable Mfg. Co., Boston, Mass.

NEWS NOTES

INCORPORATIONS.

VISALIA, CAL.—The Terra Bella Water Company has been incorporated by Marco Hellman, A. A. Hart, W. A. Francis, F. J. Thomas and I. M. Walker, all of Los Angeles, with a capital stock of $25,000.

SPOKANE, WASH.—To develop the water-power on Warner Creek, in Lake County, Ore., the Southern Oregon Water Power Company, capitalized at $300,000, has been organized and soon will start work, it is announced on a $140,000 power plant to be used in supplying light and power. The president of the company is F. H. Oliver of Spokane, and M. R. Jennings, editor of the Edmonds Journal, is vice-president.

FINANCIAL.

WENATCHEE, WASH.—The Wenatchee Electric Company and the Entiat Power Company have pooled their interests and purchased the Valley Power Company. The new company will be known as the Wenatchee Valley Gas & Electric Company, with a capitalization of $1,000,000. Arthur Gunn will be president of the company.

TACOMA, WASH.—At the meeting of the executive board the sinking fund commission was authorized to issue $200,000 bonds, the proceeds to be expended in payment for work upon the Green river gravity water system for the city of Tacoma. Of this sum $100,000 will be used for work about the intake, and the balance of the fund will be used to pay for the preliminary work at the reservoir.

SAN FRANCISCO, CAL.—The advance in the common and preferred stocks of the Pacific Gas and Electric Company is said to be founded on increased earnings and the rumor that there is to be a melon cutting next year for the holdings of the common stock. The original trust agreement provided that no dividends were to be paid on common before 1911. The big disaster of 1906 followed so close upon the heels of the organization of the Pacific Gas & Electric that small hope was then entertained of so speedy a recovery of earning power. Last year's statement showed a balance of $1,502,957. For the first six months of 1910 the balance amounts to $943,-117.31. A duplication of earnings for the second half year will afford a surplus of $3,500,000 available for distribution. Houses that have made a specialty of Pacific Gas & Electric securities are predicting 6 per cent dividends on common for next year. This would mean an annual disbursement of some $1,200,000; an outlay which the record of the past 18 months would indicate was not beyond the power of the corporation. The company carries a heavy bond issue, reaching a total of $58,933,542. Against this it lists assets of $113,757,-660. Operating in 24 counties in the central part of the State, the corporation has been able to take advantage of the great growth of the last few years. The summary of earnings for the first six months of the year follows:

Gross revenue	$7,230,538.17	
Deduce rev. in sus. (S. F. r. case)	192,470.60	$7,038,067.57
Maintenance	$ 583,678.18	
Op. exp. tax, reserves, etc	3,307,261.60	$3,890,939.78
Net revenue		$3,147,127.79
Int. (incl. int. on unify. & ref. bds)		1,511,742.27
Balance		$1,635,385.52
Div. on pfd. stock	$300,000.00	
Sinking funds	368,658.21	
Amort. of bd. dis. and exp	23,610.00	692,268.21
Balance		$ 943,117.31

TRANSMISSION.

GRANGER, WASH.—The town council has granted a 50-year franchise to the Pacific Power & Light Company.

FLORENCE, ORE.—George M. Miller and brothers have completed surveys for the construction of a water-power plant near here and are seeking a franchise for furnishing light and power to the city.

EVERSON, WASH.—The Washington Mining & Development Company, of Bellingham, let a contract to Albert Rivers of this city, for the erection of poles on the streets of this place and Nooksack.

GRANTS PASS, ORE.—M. J. Anderson of this place is working on a large power project on the South Fork of the Coquille river, about 30 miles southeast of Myrtle Point, where from 5000 to 10,000 h.p. can be developed.

OAKLAND, CAL.—The Sierra and San Francisco Power Company has applied for a franchise, under which it intends to operate a telephone line through the county. The line is to be used by the company alone and will in no way be a public service corporation. The Sierra and San Francisco Power Company has been operating in this county for two years. It has been supplying a number of local firms with power, and now intends to widen the field. Under the franchise the company proposes to run wires for the transmission of electric power, and, on the same poles, its telephone wires.

VERDI, NEV.—The hydroelectric power plant to be built on the Truckee river, a short distance east of Verdi, at the end of a big canal which will tap the Truckee near Boca, a few miles above Verdi, and will be large enough to carry all the water in the Truckee, will develop 3000 h.p. It is to be built by the Sierra-Pacific Electric Company, which was organized by W. P. Hammon and associates, and which is the holding company for the Truckee River General Electric Company, Reno Power, Light & Water Company, Washoe Power & Development Company, and Union Gas Company. The Sierra Pacific Company, has at present power plants at Farad, Washoe, Reno and Fleish, which develop 7800 h.p., but the new plant will develop nearly half as much as all these plants combined. J. B. Lukes, who is the engineer in charge of the project, states that the company has plenty of use for this additional power. Engineering parties are now in the field, and the right of way for the canal is being secured. It is stated that a sixth plant may be built just east of Reno after the completion of the proposed Verdi plant.

TRANSPORTATION.

BROWNSVILLE, ORE.—The Albany Interurban Railway Company has asked for a franchise here.

BELGRADE, MONT.—The Galaltin Valley Electric Railway Company, will build a branch from Buckley's ranch, south of Central Park, to this place.

STOCKTON, CAL.—The electric line known as the Jenny Lind line which has been completed to Linden, will be extended on to Jenny Lind at once.

EUGENE, ORE.—The franchise for the Oregon Electric Company has been granted under which the company is to have the line completed and in operation between this place and Albany within 18 months.

LOS ANGELES, CAL.—The City Clerk will receive sealed bids to 11 a. m. September 20th, for a franchise granting right to construct and for a period of 21 years to operate and maintain a double track electric railroad on Brooklyn and Evergreen avenues. H. J. Lelande, City Clerk.

CITY OF MEXICO, MEX.—The Department of Public Works has under consideration the proposed new line of the Mexico Tramways Company, which will pass through the colonies of Indianola and El Buen Tono to the general hospital.

SOUTH BEND, WASH.—J. B. Crary, former manager of the Grays Harbor Electric Light & Power Company of Aberdeen, announces that he is interested in the probable construction of an electric railway to cost $500,000 between South Bend and Raymond.

OAKLAND, CAL.—The City Council has granted to the Southern Pacific Company a 50-year franchise for the extension of its Melrose and annexed territory branch of the ferry service lines to Stanley road. The extension, as well as all of the corporation's local lines, will be electrified. The franchise grants the S. P. the right to carry freight over the road during the night.

SANTA ROSA, CAL.—Petaluma and Santa Rosa electric railway officials have bonded the summer resort known as Mirabel Park, on the Russian river, and taken options on many other pieces of property in that section. Surveys are being made from Forestville, the terminus of the road at the present time, to Mirabel Park, one mile and a half distant and construction work will be begun this fall. It is intended to build the electric line down the river westward and touch all the principal summer resorts as far as Monte Rio.

SAN FRANCISCO, CAL.—The Northern Electric Company will within a few days, issue a new time table for its trains between Sacramento, Marysville, Oroville and Chico. There will be no change in the number of trains run, but merely a change in the running time. The time between Sacramento and Marysville will be lessened about ten minutes and about that much added to the running time from Marysville to Chico. Failing to reach a settlement of the strike of linemen and operators of the Northern Electric Company with the officials of the railway in San Francisco, Hugh Murrin, president of the district council of the Electrical Workers' Union, is to take charge of the situation. So far the Northern Electric Company has been able to operate its trains notwithstanding the strike.

ILLUMINATION.

REDMOND, ORE.—The City Council has granted a franchise to the Creek County Water, Power & Light Company, a local organization for an electric lighting and power system here.

NEW ARLINGTON, CAL.—Wm. V. Lockwood, representing a large electric contracting concern is figuring with the Arlington Hotel Company, on installing a light and power plant for New Arlington.

SAN BERNARDINO CAL.—The City Council has formally declared in favor of a municipal lighting and power plant and a committee has been appointed who will report in a month the cost of installing a lighting plant.

OGDEN, UTAH.—When the present improvements planned by the Pintsch Compressor Company are completed, Ogden will have the fourth largest gas plant in the United States. The present capacity of the plant is to be increased from 50,000 to 200,000 cubic feet per day, and the work of placing the necessary equipment for the enlarged capacity is to start at once.

MYRTLE CREEK, ORE.—It has been decided to construct an electric light, heat and power system and to transmit and sell electricity at Myrtle Creek, Canyonville and Riddle if a sufficient load can be obtained. The power will be generated by steam. This plant will be a temporary one and will be replaced by a larger one in a few years. J. L. Blaisdell of Portland, Ore., is one of the men interested in the project.

WATERWORKS.

NAMPA, IDAHO.—Messrs. Dutcher and Ednie have secured the contract to install the new water system in the town of Meridian.

WESTON, ORE.—The Council has made a contract with J. Franklin, of Walla Walla, for improvements in the local waterworks system to cost $3370.

WESTON, ORE.—The city of Weston has contracted with Jesse L. Frankum of Walla Walla for improvements in the waterworks system to cost $3370.

JOSEPH, ORE.—J. Mitchell of Joseph will install a new water system for $16,800. It is the intention to connect the large feed main with Wallowa Lake, one mile south of the town.

SAN FRANCISCO, CAL.—The Board of Health has been allowed $30,000 for the purpose of equipping the infirmary at the Relief Home and $20,000 has been awarded to the Board of Public Works to provide additional plans and specifications for the auxiliary system for fire protection.

SPOKANE, WASH.—Spokane will lay plans for a gravity water system. The matter was laid before the leading citizens at a meeting of the Spokane Chamber of Commerce by Mayor N. S. Pratt, and was turned over to the Chamber's special water committee for full investigation. The cost of the plans will approximate $1,000,000.

SEATTLE, WASH.—The Vashon Country Club is being organized and has purchased 8 acres of land located on the north end of Vashon island on which it proposes to erect a club house and will also install a water system. Those interested are J. Roberts, J. Braid, B. Wadell, Geo. Francis Rowe, J. Leslie, B. Petty, R. Cameron and C. Brockhagen.

LODI, CAL.—The bids for installing the municipal water plant were opened at the meeting of the trustees and they were as follows: Williams & Belser, San Francisco, $6793; Appleton & Frederickson Bros., $6901.75; Ernest H. Fink, $7300. After the bids had been referred to the city engineer, H. H. Henderson, and City Attorney E. I. Jones, it was decided to award the contract to Williams & Belser.

OAKLAND, CAL.—The Board of Public Works has adopted a resolution recommending to the City Council that a sum be appropriated by the city for the extension of the recently installed salt water fire fighting auxiliary system along Fourteenth street from Washington to Market street. With the contemplated addition, the system will extend from Fourteenth street to First, and from Market to Oak street, and will place every part of the business district within its confines.

LOS ANGELES, CAL.—Work on the Los Angeles aqueduct is again progressing at the rate of five miles a month and is costing about $10 per lineal foot. The only problem left in completing the ditch on time is that of steam shovel work. The general work is moving faster and costing less than was anticipated. According to the original aqueduct estimates the entire work was to cost an average of $22 a lineal foot. Nearly all of the accessory and preliminary work is now out of the way, and the actual construction figures, averaging the tunnels, conduit and canal, have been reduced to $10 a foot. This includes over $1,000,000 worth of conduit covering which was not included in the original estimates. Full forces are now operating at both the north and south portals of the Elizabeth tunnel. On the 1st inst., there had been completed 22.284 feet of this tunnel and there remains but 4576 feet to put through. The Haiwee dam work is being pushed rapidly with a strong force. On the four long tunnels of the Grapevine division full crews are at work. Chief Engineer Mulholland says: "At the rate of five miles a month, as we are going now we should easily complete the work on time."

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No. 3.—STRENGTH OF CONCRETE. For given age and aggregate gives modulus of elasticity and ultimate compressive strength; also for known percentage of voids gives barrels of cement per cubic yard of rammed concrete.

Nos. 4, 5, 6.—CONCRETE STEEL. For given modulus of elasticity and ultimate compressive strength as found from No. 3 and for a given elastic limit of steel determines the percentage of reinforcement and the strength coefficient K.

No. 7.—CONCRETE STEEL. For given bending moment and strength coefficient determines the necessary weight and depth of concrete above the steel and for given percentage of steel determines the square inches of steel necessary per foot width of concrete.

No. 8.—CONCRETE STEEL. For given cross-section of steel determines the spacing for various sizes of round and steel bars.

Nos. 11, 12.—POLE LINE CONSTRUCTION. COPPER. For given length of span, given deflection and assumed temperature determines the strain at the center of the span.

No. 13.—POLE LINE CONSTRUCTION. ALUMINUM. Same as Nos. 11 and 12.

No. 14.—ELECTRIC CIRCUITS. For given horsepower or kilowatts and given voltage determines the actual amperes transmitted at various power factors for both single-phase and three-phase circuits.

No. 15.—POWER TRANSMISSION LINES. COPPER. 60-CYCLE. For given wire spacing and size determines impedance for both single-phase and three-phase circuits; also for given number of amperes determines the volts drop per mile.

No. 16.—COMPARATIVE COST OF POWER. Gives the equivalents of distillate engines, crude oil engines, non-condensing steam engines, condensing engines and electric motors at various prices of fuel.

No. 19.—ECONOMIC SIZE OF PIPE. Determines the best pipe diameter for carrying a given volume of water under a known head for various power values (dollars per horsepower year) as compared with the price of steel.

No. 20.—FLOW OF WATER IN SMALL PIPES. Determines the friction head per 1000 feet of pipe of capacity and diameter.

No. 21.—CANALS IN EARTH. For given hydraulic radius or area of cross-section and for given slope determines the carrying capacity in second-feet or miner's inches for various values of n.

No. 22.—WATER POWER. GENERATING AND PUMPING. For given quantity in second-feet or miner's inches and given head determines either the power generated or the power necessary to pump at various efficiencies.

No. 23.—STEEL PIPE LINES. For given diameter of pipe and given head or pressure per square inch determines the weight per foot and the thickness of steel for both double riveted lap joint and triple riveted butt joint pipe.

Nos. 24, 25, 26, 27, 28 and 29.—FLOW OF WATER IN PIPES. For given quantity of flow and given diameter of pipe determines the velocity in feet per second and the friction head per 1000 feet for all values of n.

No. 30.—WOOD-STAVE PIPE LINES. For given diameter of pipe and given head determines the distance between bands and the weight of metal per foot.

No. 31.—FLOW OF WATER OVER SHARP-EDGED WEIRS. (Bazin's Formula.) For observed head in feet and given height of weir determines the second-feet discharged per foot of weir length.

Nos. 32, 33, 34, 35, 36 and 37.—FLOW OF WATER IN CANALS AND FLUMES. For given hydraulic radius and given velocity determines the flow in second-feet for various values of n.

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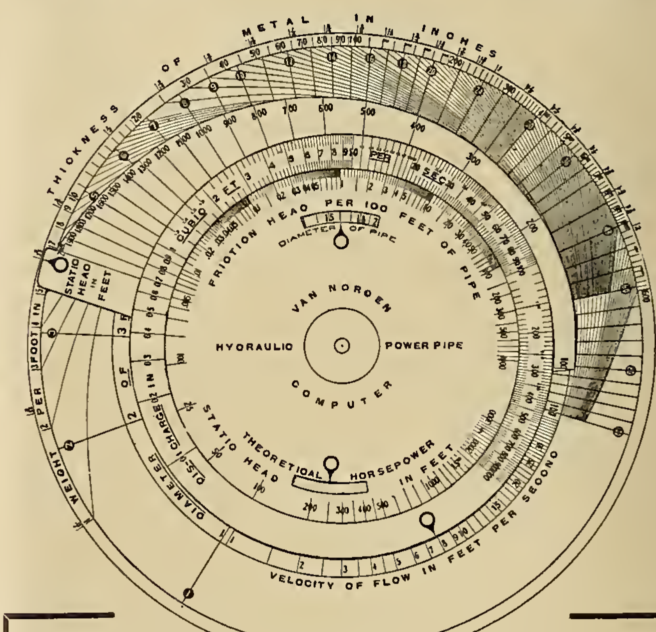

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3 1879

VOL. XXV No. 10 SAN FRANCISCO, SEPTEMBER 3, 1910 PER COPY, 10 CENTS

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

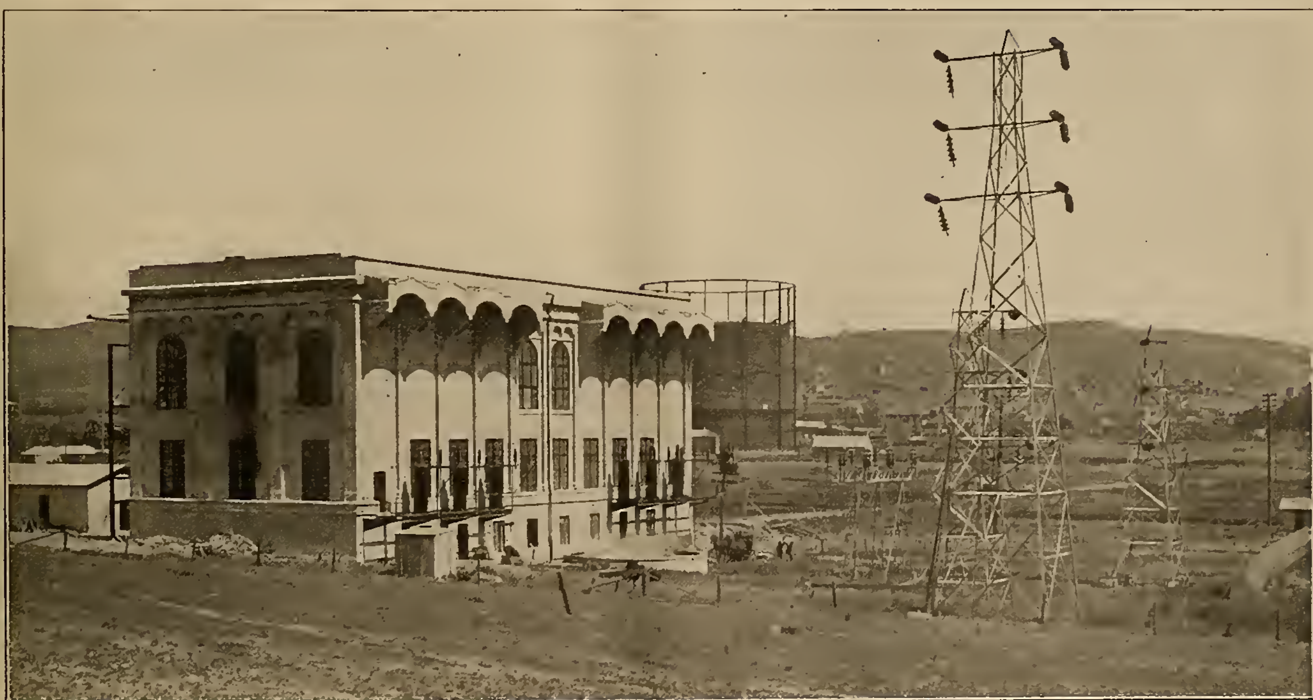
VOLUME XXV | SAN FRANCISCO, SEPTEMBER 3, 1910. | NUMBER 10

THE BAY SHORE SUBSTATION

Few San Franciscans who complain of the occasional delay in the street-car service ever stop to think that most of the power by which these cars are run is generated in the Sierra Nevada Mountains nearly 150 miles from the city of San Francisco. Only an engineer familiar with the many difficulties involved in transmitting a large amount of power such a great distance can appreciate the constant care that is necessary to avoid even a brief interruption to service.

Although it is cheaper to generate electric power by means of water, continuity of service demands that there be one or more reserve steam stations in case of emergency or at times of heavy load. So, as a matter of economy, the United Railroads of San Francisco place their main reliance for power upon the hydraulic plants in the Sierra Nevada Mountains, but have in reserve a sufficient steam power plant capacity to be thrown on as occasion demands. As described in this journal, August 21 and September 4, 1909, 20,000 kilowatts hydraulically generated on the Stanislaus river are transmitted at 100,000 volts by means of a double circuit steel tower line 135 miles long. This line terminates at the Bay Shore substation of the Sierra and San Francisco Power Company, which is illustrated herewith, and which it is the purpose of the present article to briefly describe.

This substation is situated in Visitacion Valley, south of San Francisco, and close to Martin Station of the Pacific Gas & Electric Company. Briefly stated, its function is to reduce the incoming high voltage of 100,000 to an out-going lower voltage of 12,000 for distribution to the various converting stations throughout the city and county of San Francisco. As is well known, a high voltage, while economical in transmitting power long distances, is dangerous to introduce into cities and must consequently be reduced for distribution.



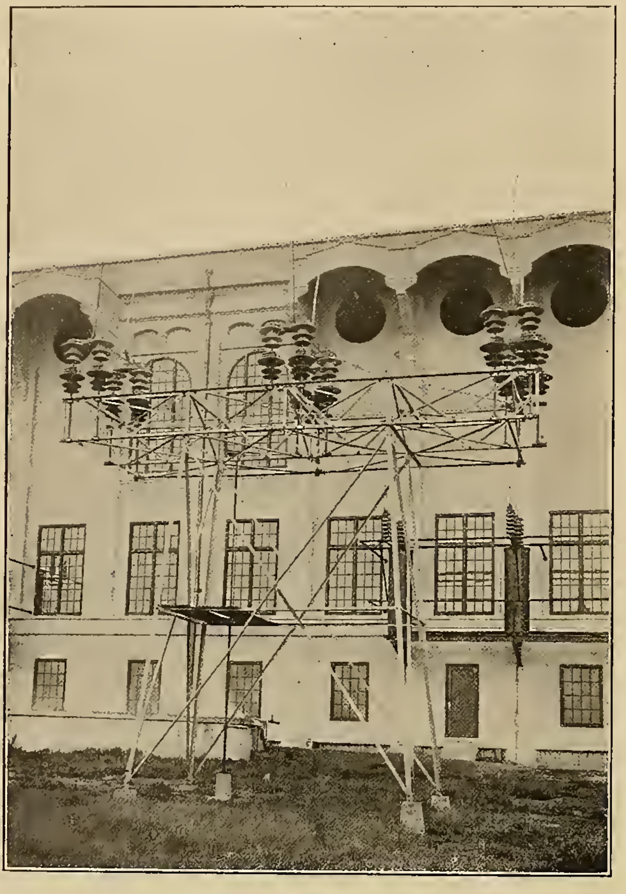
Bay Shore Substation of San Francisco & Sierra Power Co.

This is done by means of six great transformers, each having a capacity of 3750 kw. These immense transformers are the latest, though probably not the

last word in the design of apparatus to meet increasing demands for greater capacity and higher voltage. They were intended for a high tension voltage of 138,500, but before installation an insulation test of 280,000 volts was applied for one minute. The other noteworthy features of the installation are the methods of automatic switching, oil filtering and purifying system, and the means of circulating and cooling the water.

Exterior Equipment.

All of this apparatus is substantially housed in a class A re-inforced concrete structure 124 by 60 ft. in area and 60 ft. high. Provision has been made for future increase in capacity by merely building additions at either end, where the walls have been temporarily constructed of wire-lath and plaster and the steel frame adapted for easy extension. A small wing on the west side of the building contains the switchboard gallery and the storage battery equipment.


Bowie Disconnecting Switch

The sub-station faces the east and as the transmission lines come in from the south it has been necessary to change their direction through an angle of ninety degrees by means of two turning towers as illustrated on the first page. The lines are dead ended upon these towers with Locke five-element suspension-type strain insulators.

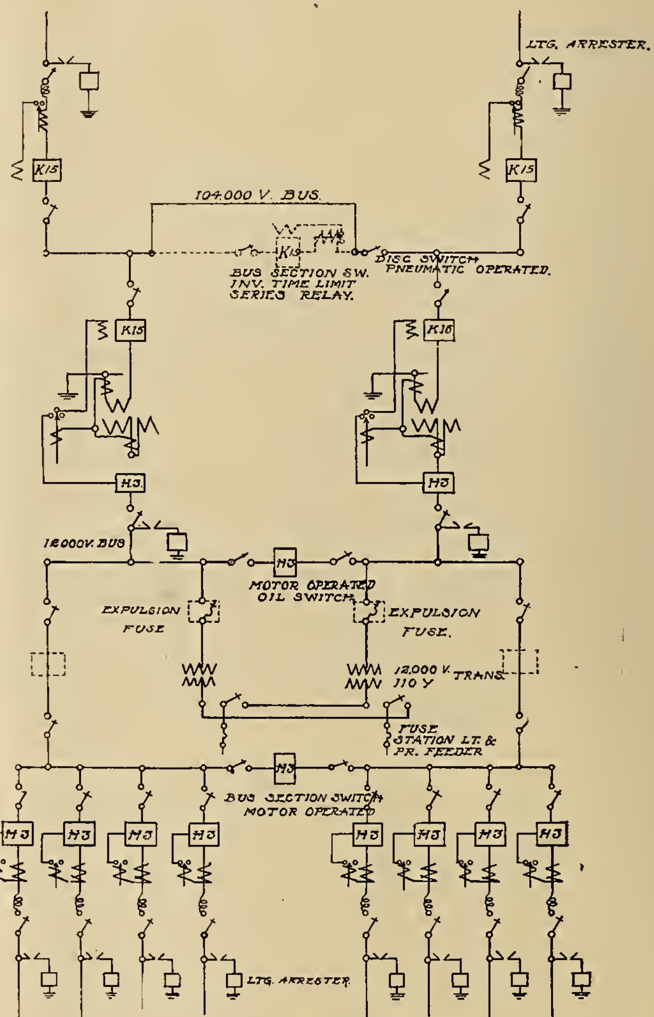
A long transmission line of this character is likely to be subjected to the effects of lightning or high frequency surges resulting from short circuits or sudden load variations, it is consequently necessary that the valuable apparatus in the sub-station, as well as the lives of the operators, be protected by every means possible. Though lightning seldom occurs on this coast, a most elaborate system of protection has nevertheless been installed, the main reliance being placed upon aluminum cell lightning arresters and upon a system of well designed grounds.

Furthermore one of the incoming circuits passes from the turning tower directly through a Bowie 104 kilovolt open break disconnecting switch just outside the building. This is manually operated and will break any arc by means of the diverging horns.

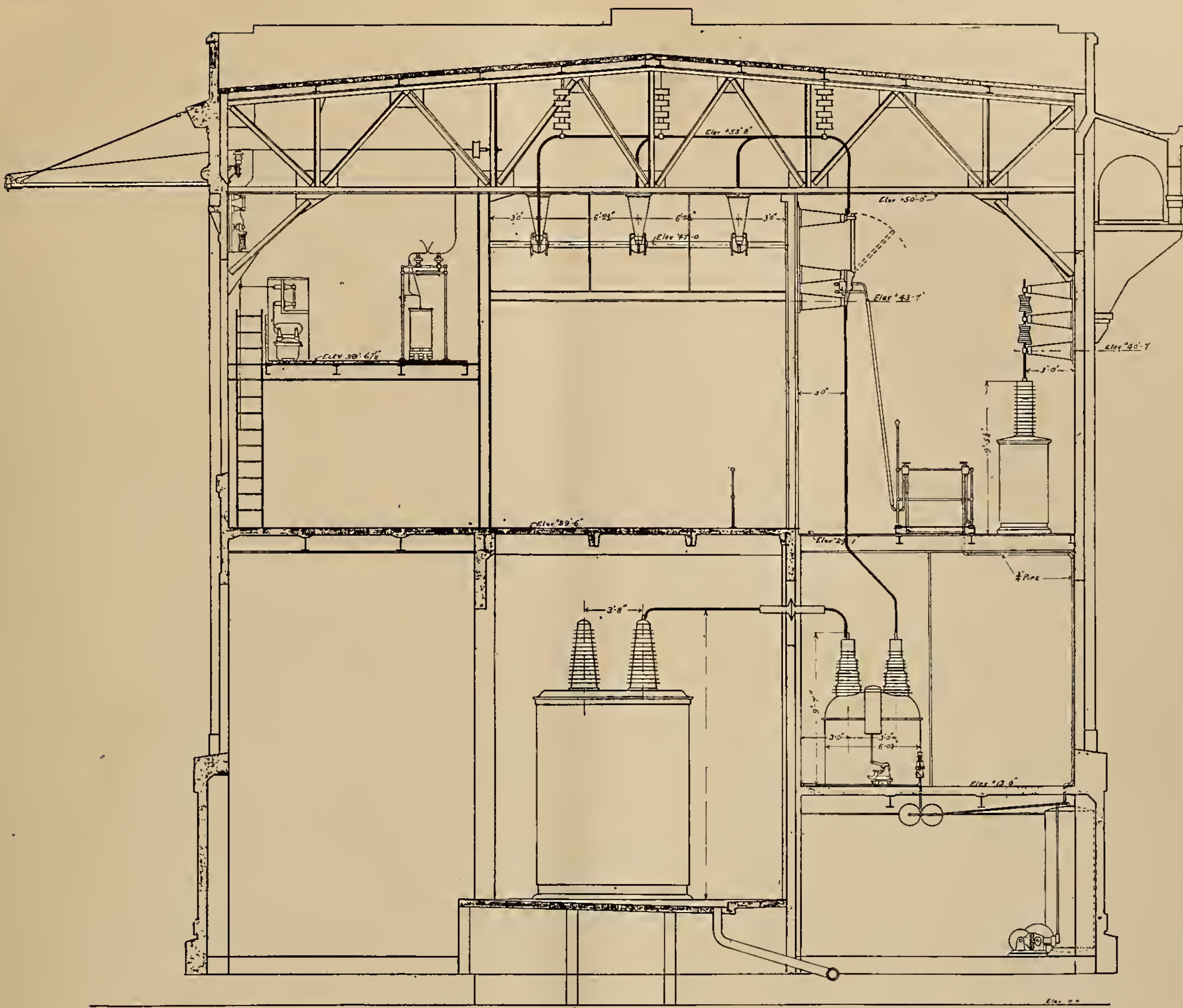
After taps have been taken off to the lightning arresters below, the two circuits are lead into the building through large open porticos giving a circular opening 6 ft. in diameter and overhung for protection against the rain. The circuits are dead-ended to the steel frame work by disc insulators.

Interior High Tension Wiring.

The system is at present run at 60 cycles, 3-phase, 104,000 volts, grounded "Y" on the high tension side, although all the high tension apparatus, except the lightning arresters, is specified as 114,000 volt. To fully understand the ensuing course of the circuits it is necessary to supplement the descriptive text with the accompanying wiring diagrams.



Plan of Substation Wiring



Typical Section of High Tension Switching Arrangement.

Inside the building and just below the entrance porticos are six pneumatically operated disconnecting switches. These are furnished with air at 80-lb pressure from two storage tanks supplied by two motor driven compressors and are controlled by two-way motorman's valves attached to the railing of the steel deck below. The same compressor outfit also supplies air for all other pneumatic switches in the building, and also for cleaning purposes.

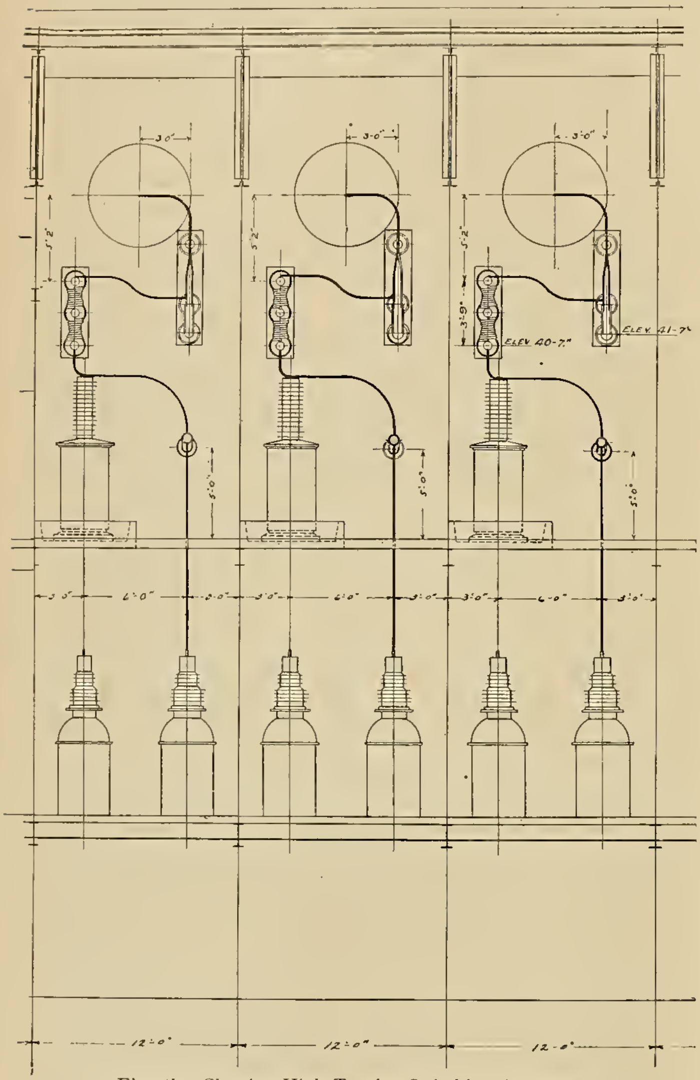
From the disconnecting switches the circuits pass through double choke-coils mounted on post type insulators, then through the current transformers, thence through and finally to the main bus to which the main transformers are connected through the K 15 oil switches and the disconnecting switches.

From the 110-volt secondaries of the current transformers wires are lead directly to the switchboard totalizing and indicating wattmeters and ammeters. In the main circuit there are also inserted 200 ampere type R 2 primary ammeters which are used primarily to determine whether the lines are alive.

K-15 Oil Switches.

The automatic circuit breakers are a special adaptation of the usual type K oil switch designated as type K 15 and designed for large capacities. As shown by the accompanying view they consist essentially of a sheet-iron tank with dome shaped top of cast-iron and filled with oil. The two lines are brought through the

cover in large insulator bushings made up of segments of insulating compound separated by fiber bushings. The switch itself is a horizontal bar suspended at the lower end of a wooden arm operated by the outside mechanism so as to make and break the contact with spring clips suspended from the bushings. As this make-and-break occurs under oil there is little danger of severe arcing. In fact 16,000 kilowatts at 104,000 volts have been interrupted with no trouble. This circuit-breaker is pneumatically operated through an electro-magnetically controlled air valve which in



Elevation Showing High Tension Switching Arrangement

turn controls the three diaphragms connected in parallel which operates the three switches. Three series trip-coils are mounted on insulators as shown in the illustration. The circuit breaker is second in importance only to the transformers and its proper design in controlling circuits of such magnitude marks the removal of one of the most serious limitations to high voltage transmission.

The main high-tension bus is of open construction, dead-ended to each end of the building and also suspended from the roof truss by disc strain insulators. If for any reason it is advisable to run one bank of transformers independently the high tension bus can be sectionalized by pneumatically operated disconnecting switches.

All high tension connections are made from ¾-in. copper tubing proven to be satisfactory and rigid as well as presenting a symmetrical and pleasing appearance.

The leads from the high tension bus to the main transformers have air-operated disconnecting switches between the bus and the transformer K-15 oil switches. Another set of disconnecting switches together with current transformers the secondaries of which operate differential relays, is placed in circuit between one end of the primary winding and the grounded neutral.

Openings in the walls of the transformer compartments have been left, together with disconnecting switches mounted on post type insulators to facilitate changing from "Y" to "delta."

Transformers.

The transformers are seven in number, one for each phase of the two incoming three-phase lines and one spare. They are of the standard oil insulated water-cooled single-phase type, each having a normal capacity of 3750 kw., primary voltage ratings of 138,500 and 104,000 when "Y" connected and several steps ranging from 40,000 to 120,000 when "delta" connected, the secondary voltage rating similarly varying from 12,000 to 3666 with delta connections and a primary normal ampere rating of 31.2 and secondary of 312.

These transformers are now being operated in two banks of three each, "Y" connected on the high tension side and "delta" on the low, stepping down from 104,000 to 12,000 volts. They have guaranteed efficiencies of 98.6, 98.5, 98.3, 97.8 and 96.0 per cent for

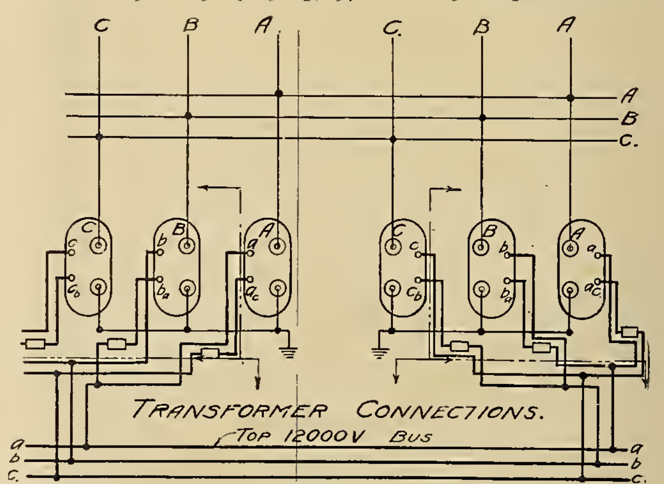
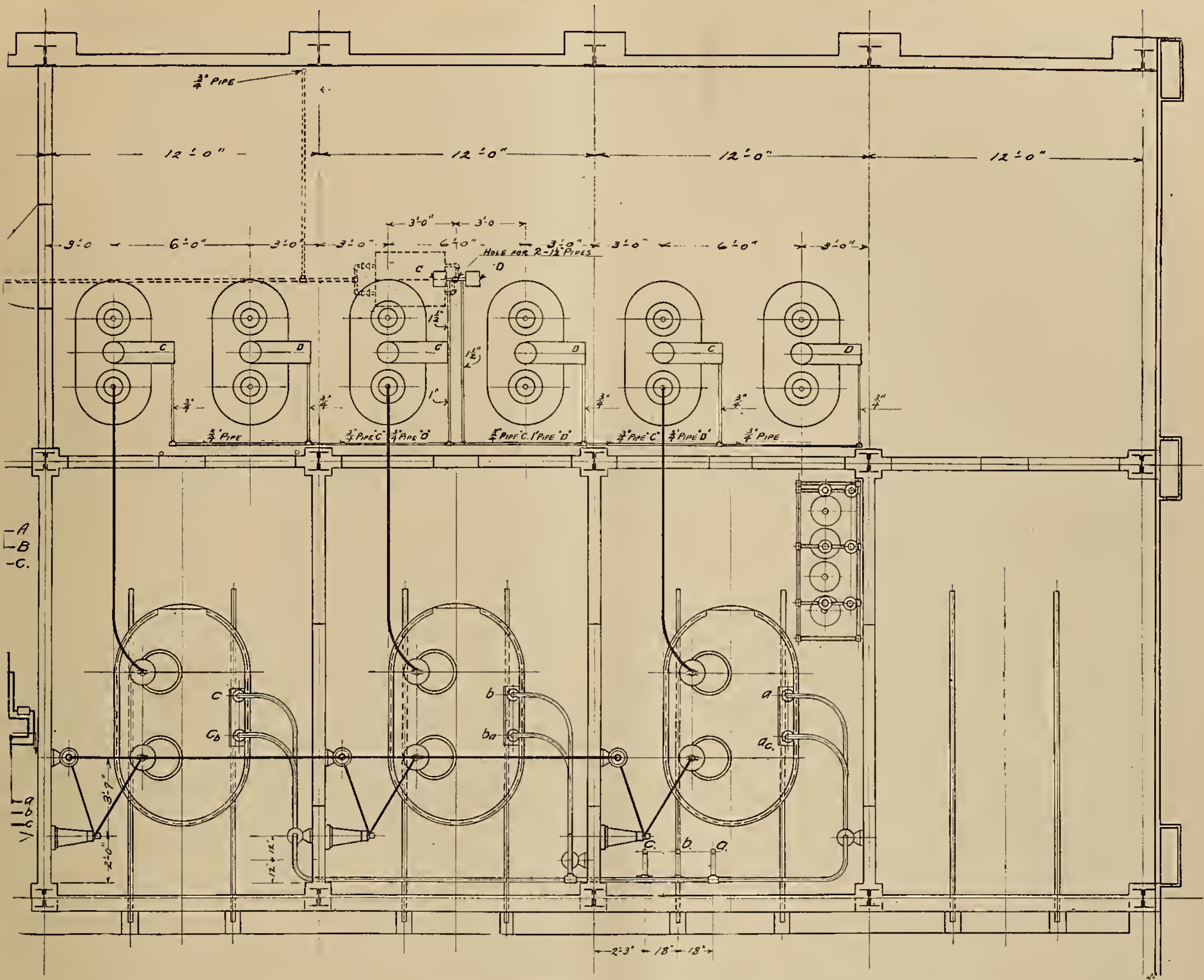


Diagram of Transformer Connections.

load and a quarter, full-load, three-quarters, one-half and one-quarter loads respectively. The non-inductive regulation is approximately 1.5 per cent at unity power factor.

They stand nearly 17 ft. high and occupy a floor space 10 by 6 ft., each being placed in a separate reinforced concrete compartment as shown in the illustration. Each unit complete with oil weighs 28 tons, 3100 gallons of No. 8 Transil oil and 20 gallons of water per minute being required per transformer.

The primary and secondary windings are subdivided into several coils, each built up of flat conductors arranged with one turn per layer so as to form thin coils presenting a large radiating surface to the oil. The excellence of the insulation is indicated



Wiring Arrangement of Transformer Connections.

by the 280,000-volt test which the coils successfully withstood. The low tension side is further protected with aluminum cell lightning arresters.

Other noteworthy features are the water-circulating system and the oil drying and purifying system.

Cooling System.

Water for cooling is pumped from a near-by well by means of a Krogh centrifugal pump driven by a 3 h.p. three-phase induction motor supplied from the station bus. Another centrifugal pump keeps the water continuously circulating through the copper cooling coils in the transformers and the spraying nozzles and cooling tank in front of the building. A duplicate set of circulating pumps is provided and the entire system has proven exceedingly efficient in cooling the water.

Oil Dryer and Purifier.

When it is necessary to purify the transformer oil, a quick opening valve allows it to flow from the transformer through a 4-in. pipe to a tank. By means of this apparatus it is possible to treat the oil while the transformers are in service. From this dirty oil tank the oil is pumped by a 2½ in. force pump driven by a 7½ h.p. motor to the filter press whence it passes into a clean oil tank and thence to the transformer through a 2 in. pressure pipe as shown in the accompanying sketch.

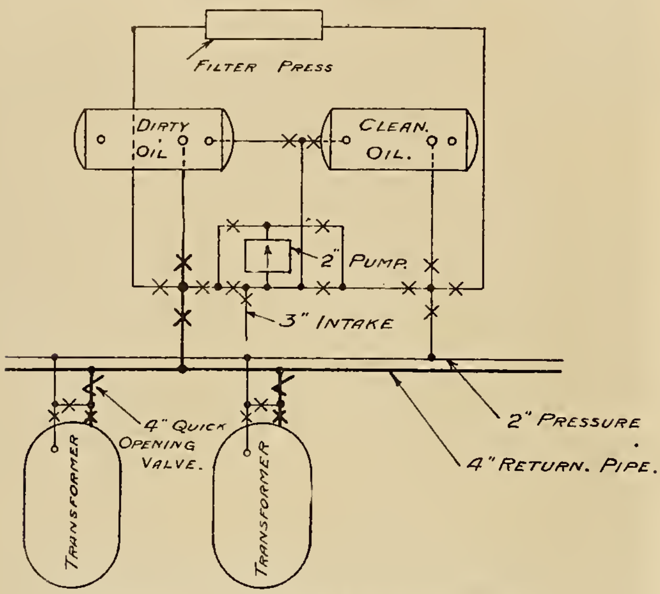
Main Transformer Compartments

This oil dryer and purifier consists essentially of a filter press, a pressure pump and an operating motor together with the necessary piping, valves, pressure gauges, etc. The press is made up of a number of alternate grids and chambers so arranged that sheets

of blotting paper may be clamped between them. By means of suitable channels and openings oil is forced into the chamber and through the blotting paper into grooves in the grids and finally out through the discharge pipe.

The filter paper catches all impurities in the oil and absorbs any moisture present, thus accomplishing a dual purpose. The foul paper is withdrawn and new paper readily inserted whenever necessary.

The press is 12 in. square, giving an area of 27 sq. ft. It is operated by a 3-h.p. three-phase induction motor, the pressure varying from 20 to 100 lb. per sq. in., depending upon the grade of the oil and its freedom from foreign matter. The outfit has a capacity



Sketch of Oil Dryer and Purifier Arrangement

of 900 gallons per hour and its total operating cost is considerably less than one dollar per thousand gallons of oil treated.

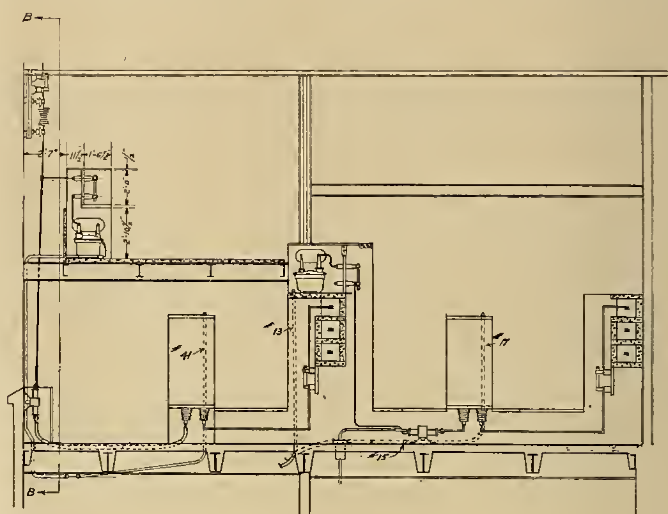
Low Tension Wiring.

Disconnecting switches have been placed in the main transformer secondary leads so that the system may be operated "open delta" if for any reason one of the transformer banks should be disabled by such an accident as a short circuit within a transformer which would set up large cross currents or surges due to the unbalanced condition. Current transformers have been connected inside the "delta" to operate the differential relay, which in turn governs the trip coils of both the type K 15 and type H 3 oil switches. The latter are placed in the 12,000 volt leads and are motor driven by direct current from a storage battery set. Taps are taken off just back of the oil switches to a set of aluminum cell lightning arresters with horn gaps carefully adjusted so as to relieve the system of any surging.

The transformer secondary type H 3 oil switches are mounted in concrete cells on a level with a false floor two feet above the main bus compartment floor, thus allowing ample clearance for the flat copper bar connections. All disconnecting switches placed in these connections are mounted in the bus structure in a vertical plane, giving an arrangement easily accessible for switching or repairs.

The transformer secondary, or main bus, runs throughout the length of the building dipping under the false floor at the center. The feeder bus parallels this main bus and both are sectionalized by type H 3 oil switches. Space has been left at the north and south ends for large capacity group oil switches, the manually operated disconnecting switches sufficing for the present.

The synchronizing and wattmeter potential transformers are mounted in concrete slab pockets placed above the buses, their fuses being mounted on insulator bases in a vertical plane convenient and safe for pulling or replacement. The feeder H 3 oil switches parallel the feeder bus, one set of disconnecting


Low Tension Switching Arrangement

switches being mounted on the bus compartment and the other under the outgoing feeder exits, being operated by means of a switch stick from the feeder lightning arrester deck.

The feeder current transformers are mounted in batteries beneath the west side window sills, being totally enclosed with asbestos board. The feeder lightning arresters are on a deck ten feet above the bus compartment floor their taps being conveniently dropped from the dead-ended feeder. On this same deck are constructed the feeded potential transformer pockets with their fuses, taps for the transformers being taken from the outgoing feeders just below the choke coils.

Switchboard.

The switchboard gallery, together with the storage battery equipment under it, occupies the wing on the west side of the main building. The switchboard proper consists of two parts, a front section and a back section. The front section has a bench-board consisting of five panels and bench upon which the bus-bar system is laid out in miniature; the five panels include two line panels, two feeder panels and a tie panel placed between them.

The line panels control the two incoming 104,000 volt lines and are each equipped with one a.c. ammeter, having an 800 ampere scale and connected to a three way ammeter switch by which it is possible to determine the current upon each one of the three incoming lines comprising the circuit; one polyphase indi-

Low Tension Switches

cating wattmeter with a scale for indicating the wattless component, and one a.c. voltmeter with a 20,000 volt scale. All these instruments give readings on the low tension side.

The two feeder panels control the eight 12,000 volt, 250 ampere, three-phase feeder circuits, the instruments for four circuits being mounted upon each panel, including one a.c. ammeter with a 300 ampere scale, one polyphase indicating wattmeter with 6000 kw. scale, and one balanced three-phase power factor indicator with 60-100-60 per cent scale for each of the eight circuits.

The central tie panel is equipped with a synchroscope, a vibrating reed frequency indicator and an a.c. volt-meter with a 20,000 volt scale.

On the back boards are mounted induction recording and polyphase curve drawing wattmeters and curve drawing voltmeters for the corresponding incoming and outgoing lines. This board has been designed for future extension of station capacity and the addition of such other instruments as may be needed.

Storage Battery Equipment.

Current for lighting the building and operating the motor driven switches must be independent of any line break-downs and is consequently provided from a storage battery set charged by a motor generator installed under the switchboard gallery. The motor generator consists of a 5 kw., 125 volt shunt wound generator driven by a 110 volt three-phase 60 cycle 7½ h.p. induction motor. The motor is started through a compensator having its own switches and fuses. The battery equipment consists of 62 type E-7 "Chloride" accumulator cells. An independent switchboard or battery charging panel has been mounted nearby with the usual instrument equipment. Current for all power and lighting auxiliaries is derived from two banks, three each, of 60 kw. station transformers, stepping the voltage down from 12,000 to 110. Adjoining it is a board controlling all the station lighting and power equipment.

All the apparatus, except where otherwise noted was manufactured by the General Electric Company. The plant was designed and installed by Sanderson & Porter, Otto Falch superintending the local designing and William Hutton the construction. The editor is indebted to Geo. S. Johnson, who did much of the detail designing, for collaboration in preparing this article. This substation, together with the generating plant and transmission line is operated by the Sierra & San Francisco Company.

Examination for Civil Engineer and Superintendent of Construction is announced by the United States Civil Service Commission on September 14-15, 1910, to fill vacancies in the position of civil engineer and superintendent of construction, $1500 per annum each, in the Quartermaster's Department at Large, San Francisco, Cal., Fort Bayard, New Mexico, and Washington, D. C.

RATIONAL UTILIZATION OF WATER-POWER

BY J. J. BROWNE.[1]

We believe in conservation, but we are also in favor of progress and development. Our public lands should be used for the purposes to which they are best adapted, but not abused; the mines should be made to give up their wealth, but not destroyed; the timber should be cut in such a manner as not to wipe out our forests, and our water powers should be developed, as we need them for hundreds of civilizing purposes all over the Rocky Mountain and Pacific States.

To carry out the ideas of the ultra conservationists in this matter of federal control of our public lands and water powers, mineral, forest and other natural resources, would greatly retard the development of the Northwestern and Pacific States and Alaska, without adequate compensation to the nation as a whole. The average conservationist has been made to take an extreme position on this important question, owing largely to having only one-sided information. But there is another side, which, in fairness, ought to be understood.

The total horsepower of water in the United States is estimated at 66,518,500, and of this more than one-third is in Washington, Oregon, Idaho and Western Montana. Less than $500,000 horsepower is developed. It may also be noted that nearly all the remaining public lands are located in the Rocky Mountain and Pacific States and Alaska. East of the Mississippi river are 20,000,000 horsepower of water and only 4,000,000 developed.

In the Columbia river valley, between the Rocky Mountains on the east and the Cascades on the west, there is sufficient water for all purposes of the present day and for generations to come, including the operation of all the railroads and irrigation projects we shall ever need, all the manufacturing we shall ever do and all the cities we shall ever build. That water-power is so great that if 10,000 horsepower of it on an average should be developed every year, it would take, 2400 years before all of it would be in use, and when once in use it would be so for all time. If we were to harness 100,000 horsepower a year, it would require more than 240 years to develop all of it.

Water-powers are local and confined in their operation to comparatively small areas. Each community needs power to manufacture its raw materials. If the land upon which these powers are located is restored to entry under existing laws, the titles for the most part will go to bona fide settlers living in the several communities, and will largely be developed by local capital. Water-powers on public lands are not located in cities, but in the wilderness or in sparsely settled districts, and if the power should be a large one, it will take many years for its full development. No man can afford to devote his time and money developing such a power under a leasehold. He needs the title in fee simple. He is not building for himself alone, but for posterity.

The government should cancel its withdrawal of those lands and dispose of them to the people who need them and will use them. In the very nature of the case there can be no monopoly in this matter. The States respectively own the water in the rivers within their boundaries, subject only to the right of navigation, which is controlled by the federal government. This principle is so generally recognized that every well-read lawyer is familiar with the decisions of the courts justifying it.

Each State has full power to regulate the water-powers within its boundaries, and the federal government should either give the settler the title in fee simple to those lands, or turn the lands containing water-powers and coal and minerals, over to the States. The present policy is retarding development, and progress must soon cease unless it can be changed. The people should be given every opportunity to develop the country in which they live. As the State already owns the water, why should it not own the land also? All these lands, with coal and mineral and other deposits should be turned over to the States, which alone have the power to take and to regulate the industries that may result from these mineral resources.

Many water-powers in our territory, including a large number along the Snake river, have been withdrawn by the government recently, and the result today is that numerous projects to establish manufacturies are held up. Capitalists and owners of factories in the New England, eastern and middle western States would operate more mills and plants in our country, but under existing regulations, which I hold are unlawful, these men cannot secure the land they must have if they are to develop the power. Under the old law, which gave any person the right to select land and develop power, the water-power of the East has all been developed. It is in private hands and has been from the beginning.

What we desire is the opportunity for any man in the United States to come to our country and get water and otherwise assist in developing our resources. We do not want the country standing idle, and the water running to the ocean as it has been doing for countless thousands of years. The way to get population, wealth, revenue, cities, manufacturing establishments, churches and schools into our country is to develop these water-powers. Spokane, now a city of 125,000, has grown because it is built on an immense water-power. There are many other equally valuable water-powers in the Northwest and they ought to be developed. We should have cities of from 50,000 to 150,000 all over the western country and we would have them if permitted to develop the wealth at our doors."

[1]President of Western Conservation League and Chairman of Spokane delegation of National Conservation Congress in St. Paul, September 5 to 9.

An examination for inspector of construction is announced by the United States Civil Service Commission on October 5, 1910, to fill a vacancy in the position of inspector, qualified as a good all-round building inspector, male, at $900 per annum, in the Quartermaster's Department at Large, Fort Crockett, Tex., and vacancies as they may occur in any branch of the service requiring similar qualifications.

METHODS OF OBTAINING BUSINESS.[1]

BY A. C. M'MICKEN.

Probably no subject to be presented at this convention covers so wide a field and presents so many topics for discussion as "Methods of Obtaining Business," and certainly no subject has been more cussed and discussed by central station managers.

About ten years ago, in Denver, Colo., Henry L. Doherty conceived the idea of "going after" business for the central station instead of following the timeworn custom of letting the business present itself. This was the real beginning of the commercial department of central station business and you are all familiar with the wonderful success of Mr. Doherty's scheme. A few companies previous to that time had made weak endeavors toward commercial organizations, but none had conceived the organization perfected by H. L. Doherty and none had met with much success.

The commercial department is the first requisite in the business-getting game. Due to the extremely rapid growth of our Pacific northwestern cities aggressive commercial departments were not considered a neecssity until a few years ago. Central station managers had difficulty in caring for the wonderful natural increase in business and few could see where a commercial or new business department would be of much benefit.

We are all, now, fully aware of the absolute necessity of a business-getting department in both large and small cities. Especially is this true of the small plant even if the department consists of but one good man. Stations in cities of 5000 or more can afford a commercial man. It is manifestly unwise, if not impossible, for the small plant manager to add to his duties as superintendent, bookkeeper, and lineman, the work of commercial manager and solicitor. This is the age of specialization and trained commercial men are just as necessary as electrical engineers.

The good commercial man has established his position as of equal importance with the engineer, and who can say that the day is not near at hand when the commercial manager will overshadow the engineer. Commercial work no longer merely constitutes soliciting for business, but now in a great measure dictates company policy.

The regular commercial organization consisting of the manager, the district representatives or solicitors, the power man, the sign man, illuminating engineer, and other specialty men is doubtless familiar to all of us. It is needless to say that the success of the commercial department depends entirely upon the personel of the men composing it and the support given it by the company.

One of the greatest assets in getting business is publicity—advertising, if you please. Many central stations are slow to realize the benefits of intelligent, educating, interesting advertising. Educate the public to the necessity of electricity and variety of its application and you have paved the way for your representatives "call" which is sure to show unexpected results. Many central station managers use a little space in the daily papers for the sake of friendship of the paper, and usually run some hackneyed phrase year in and year out. This is not advertising. Both newspaper and bill-board advertising can be used with the most gratifying results. Illuminated bill-boards calling the attention in a concise, catching way to electric heating and cooking devices and high efficiency lamps have proved their worth. In newspapers, bulletins should be run familiarizing the public with operating as well as commercial conditions. Other bulletins should also be published explaining the operation of motors on various power applications, the use and design of cooking and heating utensils, fans, high efficiency lamps, the necessity of scientific illumination of stores and other buildings, and decorative lighting. "Flyers" should be enclosed with the monthly bills calling attention to some particular household device such as toasters, irons, etc. Most of the largest central stations in the country, such as New York, Boston, Chicago, and Philadelphia advertise very extensively in these ways with most gratifying results.

The display room as an advertising and business getting medium must not be overlooked. Too much stress cannot be laid on the value of such a room. In Portland we have a demonstrator on duty at all times to give practical demonstrations of the use and efficiency of various heating and cooking utensils. Her reports for the first six months of this year show that her sale of electrical devices has averaged better than $600 per month; this does not include the ordinary sales made in our electric store but only her personal work. That the addition of this class of business to our load is most desirable goes without saying.

In many of the larger cities of the country, the display room is combined with a retail store where most of the devices displayed are also sold. Chicago, Boston, Philadelphia, St. Louis, Denver and others follow this method. In most of these places standard retail prices are maintained and the stores are self-supporting and profitable. In a few cases goods are sold at cost with a view of stimulating sales. It is believed that this practice is bad as it interferes with exploitation by supply dealers, and destroys their interest. If central stations sell appliances, it should be at regular retail prices.

Many central stations sell current consuming devices on installments which is unquestionably a good scheme if closely watched for credit. Chicago recently distributed 2500 electric toasters, payments being made at $0.40 per month for 12 months. Collections were made with the monthly lighting bill.

We have recently tried what we call "District Demonstrating" with excellent results. In different parts of our city arrangements were made to hold demonstrations of electric heating and cooking devices in the leading grocery and mercantile stores. Cards were mailed to the house-wives in the territory in which the demonstration was to be made inviting them to attend. An attractive window display of electric devices was installed and the demonstration lasting one or two weeks was conducted by our regular demonstrator. All manner of devices were on sale, a percentage of the profits going to the proprietor of the store, thus compensating him for the floor space used. A solicitor was also on duty at all of the demonstrations and a large amount of residence lighting was se-

[1]Paper read at convention N. W. Electric Light & Power Association, Seattle, Wash., Aug. 26-29, 1910.

cured solely through the desire of the housewives to use electric irons and other devices.

The securing of residence business has been a popular topic for discussion for some time past and numerous articles have been published in the various electrical journals which have thoroughly covered this very interesting problem.

From the number of inquiries received I find that many central station managers have asked, "To what extent is the central station justified in doing free wiring?" This question arises from the fact that in many of our cities a large number of the older residences and buildings have never been wired, due either to the gas company being in the field first, or to the fact that at the time of building electric lighting rates were prohibitive. We believe it is both unnecessary and unwise for the central station to do any free wiring.

One of the members of this Association informs me that he was able to add more than 1000 residences to the load of the central station by wiring the houses at cost for the consumer and allowing him to pay for this wiring in monthly installments covering a period not longer than five months. This was all done without loss to the central station.

Probably the most essential requisite to all central stations is a good "power" load. By the word "power" I mean all uses for electrical energy other than for ordinary lighting. This is the most difficult business to secure and it is at the same time the most desirable from every viewpoint. In thinking of the word "power," motor applications first come to mind. I believe that none of us have had much difficulty in securing small motor loads, for the public generally realizes that no drive compares with the electric motor in efficiency and cost of operation for small power purposes. Our greatest difficulty arises in securing power business from the larger manufacturing industries who have sufficient load to warrant the installation of steam or other motive power than electricity. Six years ago in Portland the motor load consisted of about 400 motors aggregating about 3500 horsepower. This load consisted mostly of electric elevators and small motor installations, machine shops, printing shops, etc. Owing to the low price of fuel easily obtained from the numerous sawmills in the city, most of the larger manufacturing concerns were operating by steam. Fuel oil at that time sold for 65c per barrel. A systematic campaign was instituted to win over as much of this business as possible. All of the different manufacturers were classified under their respective business, foundries, machine shops, printers, planing mills, brick yards, etc. Data was secured showing the hours of operation, the amount of power used and the approximate operating expense. If the engines or boilers were old or in poor condition special note was made of this fact and these firms were placed at the head of the list as the best prospects.

Literature on electric drive was mailed from time to time and in this manner much interest was aroused. Personal solicitation and good hard work won over a majority of these concerns, but a number of the larger manufacturing firms could not be reached. The company then decided to put in three or four complete motor installations in some of the largest and most representative factories and assume all the expense of a ninety-day trial. If the installation proved as represented at the end of ninety days, the customer was to purchase same outright; if not satisfactory, the company was to bear all expense. This was done and proved entirely satisfactory. Numerous manufacturers who had previously been very skeptical were now ready to talk electric power and new confidence in the company was inspired.

A special power man is always in the employ of the company who not only looks out for every opportunity to install electric drive, but also makes suggestions for bettering the installations of present customers. In many instances he is called upon to "lay out" the entire equipment of machine shops, factories, etc. This, of course, presents splendid opportunities for applying motors. Very friendly relations are maintained with machinery houses, architects and engineers, and through them new business opportunities are located promptly.

As a result of systematically following up power prospects we have at present a motor load aggregating 25,000 horsepower.

Other uses for electric energy which may properly come under the heading "power" and which are more or less special applications and must be treated as such are, mercury arc rectifiers, battery and automobile charging, cooking, heating, and industrial appliances; dental and tonsorial apparatus, artificial refrigeration, vacuum cleaning, blowers, musical instruments; the use of current in hospitals, bakeries, confectionery and ice cream factories, etc. In securing this class of business it is essential that a trained man be employed to devote his entire time and energy to this work.

Too much attention cannot be given to the electric automobile business. Some stations are selling "electrics" keeping one or more men soliciting and having a car on display in their display room and demonstrating to customers as desired. Some maintain a charging and repair station. Others co-operate with dealers by running strong ads in the newspapers. It is rapidly becoming a large factor in current consumption and no station can afford to overlook it. It is new business of the newest kind.

Of the lighting business, the long hour burning "commercial" customer is the most desirable. Multitudinous are the ways of securing patronage and too much credit cannot be given the solicitor who works in the business territory. A knowledge of illuminating engineering is very essential to the solicitor in the business territory as his suggestions for better illumination are usually gratefully received and are the means of securing and holding many desirable customers.

In the larger cities I believe that the Illuminating Engineering Department is an absolute necessity. The work done by the Illuminating Engineering Department in Portland in the three years past fully bears out this statement. At the present time three men comprise this department. Their entire time is devoted to improving the standard of illumination, both of business already on our lines and new business about to be added. They are in close touch with all of the architects and so friendly are our relations that with one exception all of the architects submit the plans of new buildings and stores to us for complete lighting schemes and specifications. In this way we are able to encourage better illumination, to hold

up the wattage where high efficiency lamps are used, and best of all, to have satisfied customers on our books.

In Portland the introduction of high efficiency lamps has been a boon and not a detriment. They have made it possible for us to successfully compete with gas both in illumination and in cost. Hundreds of gas arcs have been replaced with the Mazda lamps and it has been possible to add much desirable business on already established lines. In almost every instance where arc lamps, Nernst lamps, gem and carbon filament lamps have been replaced with the Mazda lamp, high efficiency lamps of equal wattage have been installed on the basis of more light for the same money.

Controlled flat rate service which includes sign and bill-board lighting, window lighting and ornamental street lighting is most desirable both from the viewpoint of income and load. In the year past we have been paying particular attention to sign and boulevard post lighting. This class of business brings a revenue of $111.50 per kw. year and is also most valuable advertising. Of the two, post lighting is the hardest to secure, as our company did not care to carry an investment of from $75.00 to $100.00 per post and great difficulty was experienced in selling the posts to the customer. We finally evolved a scheme of organizing street improvements associations composed of all the property owners on a street. This was done by inducing the property owners who were favorable to boulevard post lighting to call a mass meeting of the property owners on their street on one pretext or other, thus giving us an opportunity to present the plan.

This was first done on Seventh street and so enthusiastically was the plan for lighting Seventh street received that the property owners incorporated under the name of the Seventh Street Improvement Association and we secured the illumination of the entire street—the association buying the posts and contracting with us to light the same for five years. A few of the property owners who were not in favor of this lighting were soon brought into line by the owners of adjoining property. The illumination of one street create a demand for this lighting on other streets and where we were not successful in forming street associations, we were able to sell the post to the individual property owner. In no case was less than a five-year lighting contract made. At the present time we have installed some 445 posts.

Many central stations have special electric sign departments where signs are designed, built and sold to the customer. Some central stations rent or lend electric signs to their customers but this plan is open to many objections. It is unquestionably better to have the customer own his sign, for he will not be so ready to have it taken down if he tires of it and he will be more particular about having "something different" from his competitor. In electric sign business "variety" is an absolute necessity. Nothing will kill sign business so quickly as a sameness of appearance and design.

I wish to emphasize the neecssity of trained commercial men. Too much value cannot be placed on the services of competent, versatile commercial representatives, as no business requires a greater knowledge of more subjects than central station commercial work.

Summarizing.

Constant solicitation on established feeders. Ample, trained, soliciting capacity to see and develop new fields. Advertising in attractive and varied form. Display rooms well equipped with current consuming devices. Popular demonstration of electrical applications. Engineering advice available free to customers.

Let us hope that the future sessions of this convention will devote more thought, more interest, and more time to this important feature of central station management. The Commercial Day session should and must be given more prominence. Let us have it a clearing house of information that will be of inestimable value to every member of this association.

ITALY'S ELECTRICAL UTILIZATION.

Continued activity is noted by Consul John Q. Wood of Venice in the exploitation of new hydro-electric plants of North Italy. Work is progressing rapidly on the 9000-h.p. works at Ponte della Serra in the Province of Belluno, under the direction of three electrical companies, one of which is the Edison (Italian company), whose central office is located in Milan. The Milani hydro-electrical plant, producing a force of 10,000 horsepower, was inaugurated in November, near the city of Verona. The electrical equipment was supplied by the Westinghouse Company of Havre.

Electric car lines are springing up in all parts of this district, enormously stimulated by the cheap electric power. The State frequently subsidizes these companies, as in the case of the line from Belluno to Pieve di Cadore, which will receive $115 per kilometer (0.62 of a mile). Railroad activities are also progressing. The line from Bologna to Verona is nearing completion, much to the regret of the citizens of Padua and Vicenza, for these cities will be cut off from the international line to and from Milan and Bologna, and incidentally Venice will lose many visitors who have been accustomed to stop off at Padua and pay a little visit to Venice before proceeding north or south

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Examination for electrical assistant is announced by the United States Civil Service Commission on October 5, 1910, to fill a vacancy in the position of electrical assistant in the Signal Service at Large, at New York City, at $1500 per annum, and vacancies requiring similar qualifications as they may occur in any branch of the service. The examination will consist of practical questions in electrical science, practical questions in the installation of electrical instruments and construction, with particular attention to cable installation, inspection and testing, training and experience. Applicants should be thoroughly familiar with the practical side of electricity as applied to telegraph, telephone, and cable engineering, and should have a practical knowledge of the methods of manufacture of subterranean, aerial, and submarine cables, both rubber and paper insulated, and insulated wires of various kinds, and of the properties both physical and chemical of the substances used in the process of their manufacture.

HOW CAN A PUBLIC UTILITY CORPORATION BEST SECURE AND RETAIN THE FAVOR OF THE PUBLIC?

BY EDITH T. TAYLOR.[1]

A public service corporation, working on the right principle, desires the friendship of the people it serves and of the public at large. It is not the individual alone, it is the corporation that wants the favor of the city that gives them a franchise; to win the approval of the City Council, not merely for the good it will do them, but for the sake of promoting good fellowship. It courts the favor of the newspapers, who can, in a few lines, make or mar a situation which is all-important to the company. All these things conspire to win approval, and approval begets friendship.

The public service corporation is not, and cannot be a success, without friendship—for it is the spirit of the age to make an artistic triumph of the business in which we engage, which cannot fail to excite the respect and admiration of the world we serve, and respect and admiration are synonymous with friendship. And it is more and more realized that without friends a business cannot continue to rise and grow to the benefit of those vitally interested. For a time a company may hold full sway and conduct things in a high-handed manner; but by and by the field is entered by competitors, who will play merry mischief with the concern which is not safe-guarded by the warm friends that should rightfully belong to it.

Any business appreciates that first necessity, to produce goods which are pleasing; and, second, to render a service that is satisfactory. The public service corporation faces a difficult proposition, as compared with other types of business, inasmuch as its field is so large that there is the greater chance of complaints; but consistant endeavor must be exerted to smooth out all troubles and satisfy all complaints. The public utility must market a perfect product, or, if not perfect, it is as nearly so as science and inventive genius have up to the minute made possible. It must, then, strive to give satisfactory service, and every conceivable opportunity to improve either product or service is to be grasped with avidity.

The human mind is constantly evolving schemes (we call them inventions) which the manufacturers, always on the alert for improvements, hear of, investigate, and, finding acceptable, adopt. The public may well be kept advised of the addition or advancement, as may be the case, and it will watch results eagerly. People are in the main charitable, but they like once in a while to be taken into the confidence of a corporation, whom they are all too ready to conclude is guilty of dark conspiracy. Make a bid for their interest and sympathy. Let them know about some of the obstacles that a big service has to meet and overcome, and arouse their interest by our efforts to please. The attitude of aloofness is, I believe, much too prevalent among the public utility corporations.

Therefore, with never-ceasing ambition to make its product as highly satisfactory as money and brains permit, the major consideration is how to give service to the consumer that shall be above approach.

[1]Paper in the Prize Competition instituted by the Spokane Falls Gas Light Company.

Here comes in the power of the employes. The outside men are chosen on account of their fine appearance, aggressiveness, desire to please and general "snap." Armed with an absolute and thorough knowledge of the business they represent, they go out to face our consumers. They are the firm's best asset, the representative in every sense. They must be courteous under all circumstances, patient and long-suffering many times; they must be sympathetic, interested and strive to win, if not a customer, at least a friend.

Other employes meet the consumer in other ways, and most important is the attitude of these employes toward the company. All at times have their grievances, real or fancied, but these should never be aired in public. A spirit of loyalty should at all times possess the conscientious employe, and he should never fail to speak well, and with praise, of the company for which he works and from which he gets his pay.

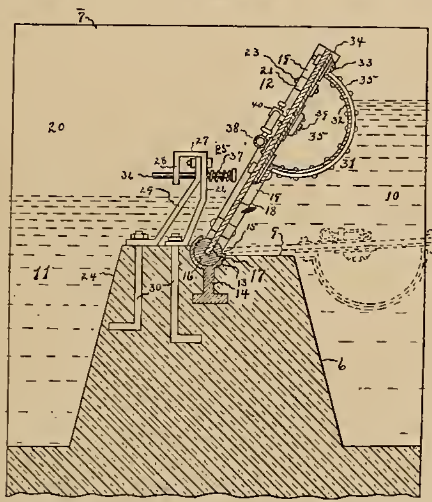
The public utility has always a carefully organized complaint department, probably the most important department from the standpoint of winning and keeping friends. Assuming that such a department is backed by an honest purpose on the part of the company, which is absolutely essential, each member of the complaint department meets the consumer, not alone with the courtesy which pleases, serious interest in the trouble exhibited, and with an assurance of ready relief and thorough attention to the complaint, but is able furthermore to know that every assertion he makes is going to be backed up by the other departments, which, with the all-imperative co-operation their employers insist upon, will each do his part to see the matter through to a conclusion to make an absolute adjustment of the trouble. But we must not rest here. We must not lose the interest we have aroused in ourselves, nor suffer the approval of the erstwhile complainant to lapse and grow cold. We must keep after the matter, communicating with the consumer to let him feel that it is as much a matter of weight with us as if it personally concerned ourselves. We will make a friend and keep him. And one friend gained is of inestimable benefit, and, after all, our best advertiser. The world is full of kind hearts, and there are very few people who would not rather be friends than enemies, no matter to whom or what.

Courteous treatment of the public at the company's place of business, I think, does more to create a favorable impression than many realize. Put yourself in the customer's place. We all like to go into a place of business where we don't have to wait-and-wait, while an employe stands in a pre-occupied manner, giving attention to something that might better wait a time. We like to be treated as though our patronage is valued; in short, we like attention. It is human nature, that's all.

All departments, working together, form a high class institution; keen business men are quick to note the careful, businesslike methods. Bill payers appreciate the efforts to set right an error and save further difficulties, and adverse criticism is turned to praise, so that we will one day, and in the very near future, be able to adopt the slogan of a notable advertiser and say, "We are advertised by our loving friends."

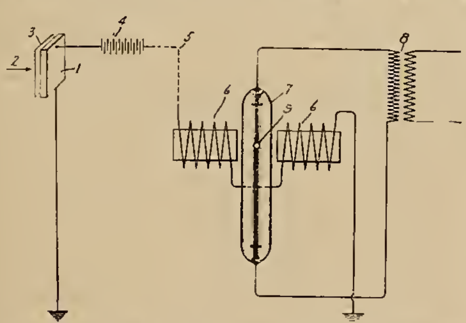
PATENTS

968,082. **Movable Crest for Dams.** Phillip Savard and Arthur Savard, Omaha, Neb. In combination with a water dam, a rectangular barrier plate disposed longitudinally of and having a mounting of one of its edges upon said dam, one of its



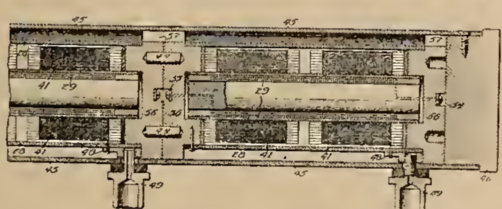
sides near its opposite edge being provided with hollow, airtight compartments; and a plurality of upright braces disposed in alinement adjacent to one of the sides of said barrier plate, said barrier plate adapted to have upwardly and downwardly swinging movements intermediate the upper ends of said braces and the other surface of said dam.

968,484. **Telephotograhpy.** Osias Otto Kruh, Schenectady, N. Y., assignor to General Electric Company. In a telephotographic system, a luminous tube having a light transmitting



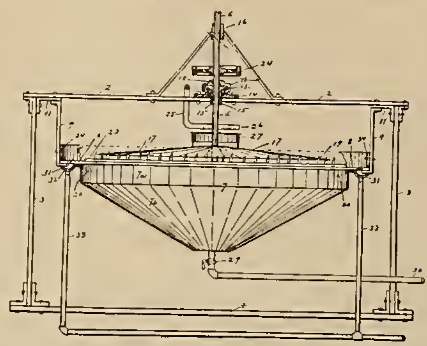
window, and electromagnetic means for varying the intensity of light at said window to correspond with the variations in current received from a distant point.

968,173. **Spark-Coil.** August R. Luschka, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. An induction coil consisting of a spool provided with a primary and a secondary winding, each end of said spool being provided



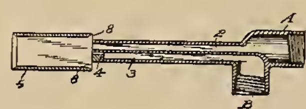
with a plurality of channels in its periphery, each spool end being further provided with a radial channel communicating with one of said other channels, terminal clips for the primary connections arranged in said radial channels, and a secondary terminal plate carried by said spool.

968,206. **Art of Separating Liquids and Apparatus Therefor.** Lawrence Strom, Los Angeles, Cal. A process for physically separating oil and water in admixture into its constituents, consisting in feeding said mixture onto a rapidly revolving surface, ejecting said mixture from said surface by



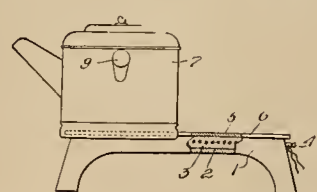
centrifugal force, dividing the ejected mixture into spray and drops by projecting it against an obstacle, and leading the oil of the mixture along the surface of said obstacle to a receiver leaving the water of said mixture to be separately dealt with.

968,281. **Oil-Burner and Draft Appliance.** Fred A. Stevens, San Francisco, Cal. In an oil burner, the combination of a pipe, the front end of which is divided by a horizontal partition into parallel steam and oil passages, said passages having greater width than height and one of said passages having a steam inlet and the other an oil inlet, a barrier at the front end of the steam passage extending across the same, to a point adjacent the partition so as to form a narrower passage



for the escape of steam, said barrier being disposed just beneath the discharge end of the oil passage whereby the jet of steam will receive the oil as it is delivered from its passage and will drive said oil forcibly forward and atomize it and mix it with the steam, and a casing or box-like extension fitted to the front end of the pipe in line with said passages, said extension having a height in excess of that of the front end of the pipe whereby openings are formed above and below the pipe for the entrance of air for admixture with the oil and steam.

968,441. **Electric-Heater Combination.** James I. Ayer, Cambridge, Mass., assignor to Simplex Electric Heating Company, Cambridge, Mass. The combination with a heater provided with a flat-top heating plate having electric heating resistance secured to its under side, of a utensil whose contents



is to be heated, one of said parts having opposite parallel longitudinal flanges substantially co-extensive with the length thereof for embracing and retaining the other part in relative snug sliding engagement in the direction of said longitudinal flanges.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong

604 Mission Street, San Francisco

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
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CONTENTS

Modern Power Stations

In the days of old, when man obtained light from the tallow dip, transportation with his own horse, water from his spring, and in fact provided independently for himself his few conveniences of life, there was no necessity of cooperation with anybody as far as he was concerned, his life was independent to a great degree and there was no necessity for him to consider anyone else or to work with his neighbor to make existence tolerable.

The hamlet as well as the metropolitan city is now provided with water, fuel, light and power from an installation which in the majority of cases is but a part of a great system. In meeting fully and adequately the needs of the people the efforts of a great many men of widely different professions and occupations are necessary. Nevertheless, each must do his part properly and accurately, at the same time not losing sight of the necessity of adapting his plans to the requirements of his associates. Expert engineering ability of the highest type must go hand in hand with capable business management and the financial problems also require the most capable handling.

The great electric power system begins with a proper conception of the opportunity. No one, whether engineer or financier, not naturally endowed with imagination and good judgment should be followed very far in a proposed utilization of natural resources or the development for commercial purposes or a newly found principle. Granted, however, that the work to be done will be of real value in the future, one is almost overwhelmed when he begins to consider the degree of engineering ability and financial acumen, coupled with sound business judgment and a proper consideration of the rights of the people, which are necessary for the real success of a great corporation such as an extensive light and power system, with which the great cities of the East and the more scattered civilization of the West are both becoming more and more familiar every day.

As a necessary part of such development there is constantly before us the relation of municipal, state and national government with such private enterprises. It is evident that in the end the best results can only obtain if complete and unqualified co-operation actually results from the composite efforts and work of all concerned. Unreasonable delays invariably result in loss of time, money and opportunity. If one wheel of the system is inoperative, whether from ignorance, malice or any other reason, the success of the plan is jeopardized.

What a degree of respect we should have for the work of those to whom credit is due when contemplating the extent of the development of, and excellent service rendered by, any one of the great electric power systems, embracing all kinds of prime movers, that are so common in every quarter of the globe. In every instance one can be assured that the best efforts of engineers, managers and financiers have all been freely given to transform the brilliant idea of someone with a great imagination into the physical and material development which is represented by the complete installation with all of its intricate details ready to serve a great people. If it should happen then that in our daily life we are fortunate enough to be a small part of the great machine of progress in the engineering world, we should not forget that our work must of necessity be supplemented and in many cases upheld by others whose responsibilities are directed in an entirely different line. It is necessary to wisely and without hesitation separate the true from the false, the reasonable from the unreasonable, the sensible from the foolish. To be wrong and to fail to right oneself when given the opportunity is a crime of which no engineer, general manager, financier or public official should ever be honestly convicted if the material progress of the latter part of the nineteenth century is to continue throughout the twentieth.

PERSONALS.

Charles C. Moore, of Chas. C. Moore & Co., has returned to San Francisco after an outing at Lake Tahoe.

E. G. Dewald, of the sales department of the Pelton Water Wheel Company, was at Los Angeles last week.

Geo. P. Cooley, of the firm of Buxbaum & Cooley, of Seattle, has returned from an extensive trip in the Eastern States.

Emory Wishon, assistant manager of the San Joaquin Light & Power Company, of Fresno, spent the past week at San Francisco.

H. C. Goldrick, San Francisco, manager of the Kellogg Switchboard & Supply Company, spent the past week in the Pacific Northwest.

Melville Dozier, Jr., assistant manager of the Northern Electric Railway Company, has returned to Chico, Cal., from an extensive Eastern trip.

W. G. Clark, consulting engineer for the North Fork Power Company is superintending the company's hydroelectric plant near Dawson.

R. F. Monges, electrical engineer with the General Electric Company's Portland office, is spending his summer vacation with relatives at Berkeley, Cal.

J. W. White, sales engineer with the San Francisco office of the Fort Wayne Electric Works, is spending a two weeks' vacation in the Santa Cruz Mountains.

George W. Bacon, of Ford, Bacon & Davis, electrical engineers of New York, arrived from the East last week and visited his firm's San Francisco office.

E. C. Jones, manager of the Gas Department of the Pacific Gas & Electric Company, returned this week from an extended tour of the principal Eastern cities.

I. P. Jones has resigned from the U. S. Reclamation Service at North Yakima, Wash., to join the staff of the Sacramento Valley Irrigation Company at Willows, Cal.

J. Hyderdahl Hansen, a hydraulic engineer with the Pelton Water Wheel Company, has just returned to San Francisco from Europe via Seattle, accompanied by his bride.

Cards are out announcing the marriage of Miss Adelaide L. Weiner to S. P. Russell, assistant manager of the electrical department of H. W. Johns-Manville Company's San Francisco office, on August 17, 1910.

H. A. Mitchell of San Francisco, who is secretary of the Central California Traction Company, was at Sacramento August 29th, on the occasion of the opening of the new 52-mile electric railway line from that city to Stockton.

E. L. Haines, electrical engineer with J. G. White & Co., of New York, was recently at Fresno, consulting with A. G. Wishon, manager of the San Joaquin Power Company in connection with the extension of the power lines into the Midway and Sunset oil fields.

Thomas Mirk, of Hunt, Mirk & Co., who recently returned from a trip to the Westinghouse Machine Company's plant at East Pittsburg, left San Francisco for San Diego during the past week. His firm is installing a turbo-generator plant for the Consolidated Gas & Electric Company of San Diego.

C. K. Durbin, general manager of the Federal Light & Traction Company (the holding company for Sanderson & Porter of New York) which owns a number of electric power and railway plants throughout the West, paid a visit to the firm's San Francisco office during the past week on his way south. He will next visit the company's plants at Tucson, Ariz., and Albuquerque, N. M. Other plants held by his company are at Las Vegas, N. M.; Hoquiam, Wash.; Aberdeen, Wash.; Hobart, Okla.; Montrose, Colo.; Sheridan, Wyo., and Rawlins, Wyo.

TRADE NOTES.

The Fort Wayne Electric Works have a contract for installing two 35 kw. 2-wire, 250 volt turbo-generator sets, together with balancer set and complete switchboard control at the Children's Hospital, San Francisco.

The General Electric Company reports the sale of a horizontal Curtis turbine generator set to the O'Connell Lumber Company, of Winlock, Wash. It is rated as follows: A. T. B. 4, 1200 k.v.a., 1800 r.p.m., 480 v., with a C. C. 2, 35 kw., 3600 125 v. shunt wound Curtis turbine exciter.

The Sierra & San Francisco Power Company has purchased of the General Electric Company one C. C. 4, 125 kw., 2400 r.p.m., 125 v., 1125 v, compound wound, horizontal, d.c. Curtis turbine, which is to be used as an exciter in connection with the two 9000 kw. Curtis turbine generator sets at the North Beach power station.

Chas. C. Moore & Co. have been awarded the contract for installing the new electric power plant on Alcatraz Island, San Francisco, Bay, including boilers, engines and generators. The latter consists of two 3-wire, 250 volt 50 kw. engine type generators, to be furnished complete with switchboard by the Fort Wayne Electric Works.

The Westinghouse Electric & Manufacturing Company has shipped to Dawson for O. N. G. Treadgold of the North Fork Power Company, a complete 6000 kw. electric plant, including two 3000 kw. water-wheel driven generators, 60 cycle, 2300 volts, 514 r.p.m., motor-generator set and 5-panel switchboard. The power company will supply electricity for dredging and mining.

The Pelton Water Wheel Company has closed a contract with the Stevens City Power and Light Company for high-class equipment for a hydroelectric plant at Myers Falls, Wash. It consists of a 550 h.p. (max.) Pelton-Francis water-wheel, with bronze runner and Pelton oil-pressure governor direct connected to a General Electric generator. The president of the company is A. H. Sperry, who is also assistant traffic manager of the Spokane & International Railway.

The Pelton Water Wheel Company reports closing a contract with the Telluride Power Company for a 1200-h.p. Pelton water wheel, for the purpose of increasing the capacity of the Howard's Fork installation. The wheel will be of special design so as to operate at two different water pressures at different seasons of the year and at the same time secure the maximum efficiency. The already large development of the system supplying the power to the Telluride and Ouray mining districts of Southern Colorado will be increased by the above amount. L. L. and P. N. Nunn, the engineers of the 100,000 h.p. Ontario development at Niagara Falls, have charge of the work.

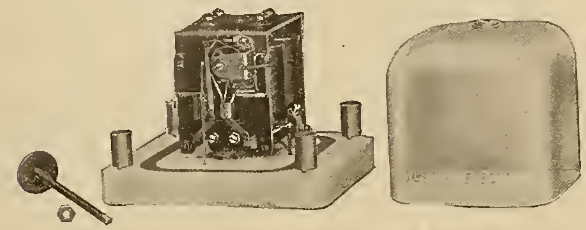
The Industrial Engineering Company of Portland, Ore., was incorporated May 1, 1910, to engage in the general business of engineers and manufacturers' agents. They are the exclusive northwest agents of the Humphrey Company of Kalamazoo, selling a full line of the well known Humphrey gas heaters; the exclusive northwest agents of the Ideal Manufacturing Company of Detroit, Mich., handling a full line of gas ranges and Ideal plumbing goods; northwest agents for the Samson Iron Works of Stockton, Cal., and are just installing for them one of the largest office building lighting and power plants on the Pacific Coast, made up of Samson four cylinder gas engines; two units driving 75 kw. Westinghouse generator, one unit driving 100 kw. Westinghouse generator. These engines furnish the light and power for the Spaulding Building of this city, and are operated on city gas. Among other lines might be mentioned a gas meter account, industrial appliances and a full line of loggers and contractors' machinery. They have excellent display rooms at 71-73 Fifth street.

INDUSTRIAL

THE OPERATION OF THE NEWEST TELEPHONE SELECTOR.

BY K. W. ENDRES.

The growth in popularity of the telephone system of train dispatching, which has recently been replacing the telegraph on many of the most important railroads of the country, has just been shown in an order placed by the Santa Fe system for over 600 Western Electric selectors. This order exceeds by more than 400 the largest order for selectors ever before reported. The Santa Fe intends to equip its whole system with



Western Electric Selector Lid Removed.

telephones for dispatching, and when improvements at present under way are completed it will have over 7,000 miles operated by the telephone.

The selector is an ingenious mechanism for calling singly the several stations along a dispatcher's section. The Atchison, Topeka & Santa Fe, intending to conform to a quality standard throughout its dispatching circuits, will equip the entire line with the newest and most improved form of selective apparatus.

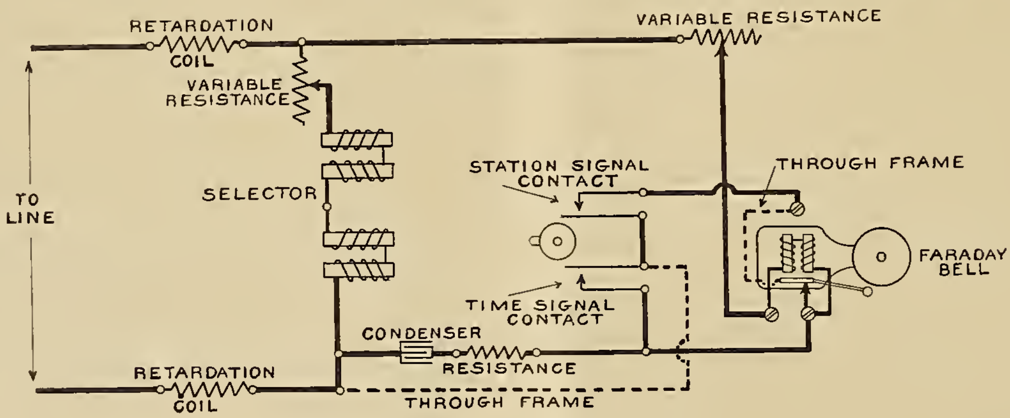
selector is supplied at all stations. The position of the moving contact with reference to the ratchet wheel and the stationary contact determines which station shall be called, and this adjustment is simple and can be made without difficulty. It is thus seen that a selector can be taken out of one station and used in another by changing its adjustment if such a thing becomes necessary in case of emergency.

The selector is mounted on a porcelain base with heavy brass binding posts for the terminal wires. The glass cover sets in a felt-lined groove on this base and is locked by a bolt and nut passing clear through the selector. It is thus rendered inaccessible to the way-station operator but can be removed if necessary by a maintenance man.

The selector is normally operated on the central energy principle—that is, the battery for stepping it around as well as the battery for ringing the bell is located at the dispatcher's office. It can, however, be arranged for local battery service if so desired.

The operation of the Western Electric selector is as follows: In front of the train dispatcher are a number of keys, one for each equipped station on the line. These keys are practically noiseless, and each one sends out a number of rapid direct current impulses on the line when it is operated. The number of impulses which are sent out can be regulated by adjustable cams on the rear of the key so that a standard key is employed in all cases and adjusted for the particular station desired. This is an improvement in train dispatching service.

The first impulse which one of these keys sends out is a long impulse, the tooth being three or four times the width



Wiring Diagram of Selector Circuit.

This new selector is a high speed, individual call mechanism and is the most simple selector in existence today. It consists of two electric-magnets or relays which are connected in series across the line. These are of a very high impedance and the number which can be bridged across a telephone circuit without affecting transmission is practically unlimited. These magnets are mounted in a brass framework on the front of which the moving parts of the mechanism are fastened; the armatures of the two magnets are at the bottom of the selector.

As will be seen from an inspection of the cut, the moving parts consist of a ratchet wheel to which is fastened a contact. This wheel is stepped around by means of a hardened steel spring pawl which appears at the top of the mechanism. This pawl and a corresponding one on the under side of the ratchet wheel are connected directly to the armatures of the magnet and, therefore, as long as the magnet operates, the pawl must move.

The contact is adjustable so that one standard form of

of the ordinary tooth. This impulse operates the magnet shown on the right-hand of the selector, which is a slow acting relay; it pulls up the armature of this magnet, which in turn causes the two pawls to engage with the ratchet wheel. The remaining quick impulses which the key sends out operate the magnet on the opposite side of the selector but do not affect the slow acting magnet, which remains held up; these quick impulses work the pawl which appears at the top of the selector and step the ratchet wheel around the proper number of teeth, at which point the two contacts make and the bell in the station is rung.

The remainder of the revolution of the key, after the signaling impulses are complete, keeps the key contact closed and, therefore, keeps battery on the line during a period of about five seconds. As long as this battery is on the line, the bell at the way-station rings.

By installing a simple strap key, the dispatcher can hold this down and make the way-station bell ring as long as he pleases, this strap key merely taking the place of the key contacts and keeping the circuit closed.

The selector is high speed in its operation. It requires approximately three seconds to call the thirtieth station on the line, and any one of the first ten stations will be called in one second or less. It is possible to place as many sets on the circuit as may be desired, this number being limited by the size of the ratchet wheel. The present selectors which are installed are equipped to care for fifty stations, which would cover the majority of train dispatching districts.

The schematic diagram shows how the selector is wired across the circuit, and also illustrates some of the auxiliary apparatus which is used in connection with it. Retardation coils are employed to choke back any lightning which may get by the protectors at a station. A variable resistance is required at each selector, since each must receive approximately the same current and voltage, and if this were not installed, the high voltage near the dispatcher would give the stations adjacent to his office much more current than they should obtain. The Western Electric selector requires approximately eight milli-amperes to operate and ring the bell and thirty volts across its terminals.

It will be noted on the schematic diagram that two contacts on the selector are shown. One of these is the station signal contact which normally rings the bell at the station when the train dispatcher wishes to call in the operator, and the other is a time signal contact which is operated by a special key in the dispatcher's cabinet and which makes on all selectors along the line simultaneously. The dispatcher can, therefore, with this key give all the way stations along his division a time signal whenever he may so desire. It also permits of his calling in all the stations at once if this ever becomes necessary on special occasions.

The condenser and resistance shown bridged around the contacts of the Faraday bell and in series with the windings of the bell are for the purpose of eliminating any spark at this contact and also serve to render the answer back signal of the proper loudness.

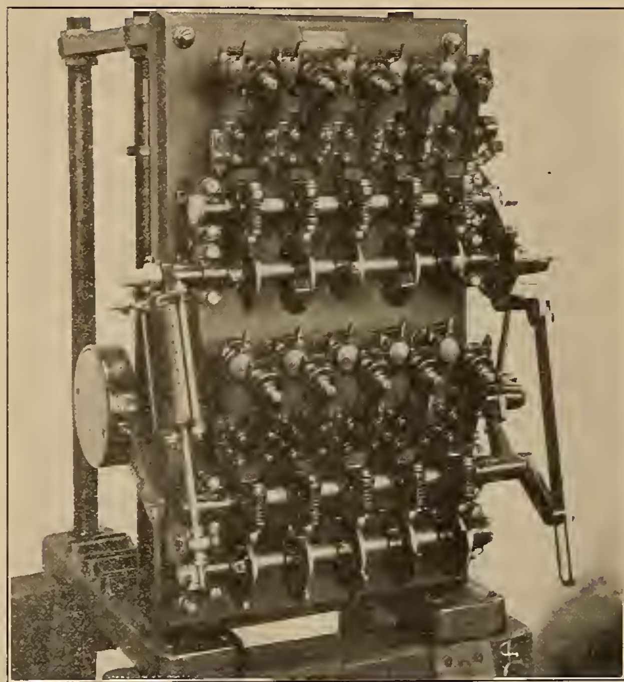
The new selector has been subjected to the most severe laboratory tests and the equivalent of many years service has been given it under test. No sign of wear in any respect developed out of 300,000 operations. The New York Central and Pennsylvania lines also have placed repeat orders for the new selector, which was given extensive experimental service on these roads.

A NEW FORM OF ALTERNATING-CURRENT ELEVATOR MOTOR CONTROLLER.

The alternating-current slip-ring induction motor is well adapted for elevator service; it has practically no wearing parts except bearings, it requires little attention, and its speed and torque characteristics are excellent for this purpose. But in spite of this, the use of alternating current for elevators has been somewhat limited on account of the difficulty in designing a suitable controlling device. Such a controller must perform a definite series of operations in an unvarying order; it must be rapid in action and yet must never complete its operation in less than a given time; and it must be incapable of disarrangement at the hands of an ignorant or careless operator. In consequence of these requirements it has been difficult to avoid complications and expense on one hand and unreliability on the other.

In a new form of alternating-current elevator controller recently placed on the market by the Westinghouse Electric and Manufacturing Company, the necessary conditions have been successfully met by means of a very simple mechanism. Every operation is performed in a positive mechanical manner. The operator has complete control over the starting and stopping of the motor, while the acceleration is performed automatically at a rate that can be adjusted over a wide range at the controller but cannot be altered by any action of the operator in the car. Any part of the controller is accessible from the front and all the parts subject to wear can be readily replaced. The electric contacts are of the quick-break, butt type and are protected by arc shields; there are no sliding contacts. All automatic operations are performed by the force of gravity.

The controller consists of a slate panel on which are mounted two rows of switches and their operating mechanism. The switches of the upper row serve to connect the motor primary with the line, and those of the lower row short-circuit the resistance in series with the motor secondary. All switches are alike and interchangeable. Five primary switches are used for a three-phase controller and six for a two-phase controller. The switches are opened and closed by cams. In closing, each cam acts on its own switch through a buffer spring which serves as a cushion and also compensates for wear; in opening, a lug on the cam engages a projection on the switch arm and forces the switch open. The resistors for the motor secondary are mounted on the rear of the panel.



A. C. Elevator Motor Controller.

The movement of a hand rope or lever in the elevator car operates a sprocket attached to the primary cam shaft. A turn of the cam shaft from the off-position closes a set of primary switches and starts the motor so that the elevator car moves up or down, according to the way the shaft is turned. The movement of the cam shaft simultaneously releases a catch and allows a weight, attached to an arm geared to the secondary cam shaft, to fall; the arm rotates the secondary cam shaft and closes the secondary switches in proper order. The fall of the weight is retarded by an air dash-pot, the piston speed of which can be so adjusted by means of a valve that proper acceleration can be given to the motor. Turning the cam shaft from the off-position in the opposite direction closes another set of primary switches and reverses the direction of rotation of the motor; the secondary switches always close in the same order.

On turning the controller to the off-position, the secondary switches are opened, the weight is raised and set ready for the next operation, and the primary switches are opened; this completely disconnects the motor from the line and stops it. The off-position is plainly indicated to the operator by a notch. Positive stops prevent over-running beyond the full speed positions.

This controller is made for use in connection with two and three-phase a.c. slip-ring induction motors of 30 h.p. and less, for all voltages under 550, and for all commercial frequencies.

NEWS NOTES

TRANSMISSION.

BEND, ORE.—Machinery for the electric light and power plant of the Bend Water, Light & Power Company has arrived and will be installed during the next few weeks. The transmission line is ready.

TACOMA, WASH.—Commissioner of Light and Water Lawson was instructed to advertise for bids for the construction of the substation power plant in this city. The estimated cost of this building is $104,000.

GOLDFIELD, NEV.—In speaking of the Lucky Boy mine recently, J. H. Miller, president of the Goldfie'd Alamo M. & L. Co., who is operating the property, said that the power line of the Pacific Hydro Power Company, which is now installing a plant near Mono Lake, will be extended to the Lucky Boy in September.

SALT LAKE CITY, UTAH.—Announcement is made from the office of the Utah Light & Railway Company, that this company intends in the near future to extend its distributing system in Davis County for the purpose of developing an electric lighting and power market in the towns and territory between Salt Lake City and Ogden.

LAS VEGAS, N. M.—Territorial Engineer V. F. Sullivan has approved the application of J. J. Laubach, Wm. Harper, W. J. Benjamin and W. B. Bunker, all of this city, for the construction of a power plant on Rio de la Casa. The plant will cost $100,000. A diversion dam 15 ft. in height and 35 ft. wide at the top and 50 ft. wide at the bottom will be built.

ALBANY, ORE.—The power transmission line of the Northwestern Corporation is being surveyed from the site of the plant at Martin's Rapids on the McKenzie river down the valley. Eugene, Springfield, Junction City, Harisburg, Albany, Corvallis, Independence, Monmouth and Dallas are among the places to be furnished with electricity. The party is now at Coberg, six miles north of Eugene.

SAN DIEGO, CAL.—Under the supervision of Andrew Ervast, engineer for the San Diego Electric Railway Company, plans have been drawn for a new power station costing about $225,000, which is to occupy practically the entire block from D to E streets, and from Arctic to California street. The company will also erect a $40,000 machine shop at the corner of Fifteenth and L streets.

SACRAMENTO, CAL.—The Great Western Power Company has almost completed the installation of machinery at its city sub-power station at Eighth and R streets, but material for installing the local retail light and power service has not all arrived from the factories in the East. It is announced at the offices of the company in this city that no definite date has been set for opening local service.

OAKLAND, CAL.—The application of the Central Light & Power Company to erect pole lines for the distribution of light and power has been referred to the Board of Public Works to the city engineer and city electricians. The company desires to erect the poles at First and Alice streets, thence to Second to Harrison, to Twelfth; also on First, Webster, Third, Oak, Fifth, Sixth, Franklin and adjacent streets.

RENO, NEV.—The Sierra Pacific Power Company, which is the holding company of the Truckee River General Electric Company and the Reno Power Company, has applied for 500 feet of water from the Truckee river, to be taken a short distance above Verdi and carried to a big reservoir. From this reservoir it will be carried in steel and wooden pipes to a site near the Washoe power plant, where the new power plant, capable of developing 3000 h.p., will be erected.

BEND, ORE.—R. G. Gould has returned from Crescent, where he has been engaged in engineering work on a power proposition. Mr. Gould, after a couple of weeks of preliminary surveying and prospecting, found the best dam location about a mile below the Crescent townsite on the Little Deschutes. The proposed dam will be 150 feet long and 15 feet high. A ditch about 5000 feet in length will have to be built to lead the water to a location adaptable to the best production of power. The survey work is being done in the interests of Dr. N. E. Winnard of Albany and others interested with him.

STOCKTON, WASH.—With the permission to erect a power plant with a daily capacity of 25,000 h.p. on the Pend Oreil'e River near Waneta granted, the Pacific Exploration Company is preparing for active operations. W. H. Jones of Portland and a number of Spokane capitalists are interested in the new project, and H. G. Hall of Nelson, B. C., will be president, J. W. Falls, manager, and A. Y. Lorch, secretary. Electric power for the Pend Oreille Valley, Sheep Creek and Ymir districts and the Orient, Chewiah and Metaline districts will be supplied, while the Northport smelter will be another consumer.

SAN FRANCISCO, CAL.—A. G. Wishon says: "The San Joaquin Power Co. is planning to hang some 2,000,000 pounds of wire in its valley power lines. The routes provide for 400 miles of wire. In six months we will have current supplied to the Midway and Sunset oil fields. There will be 350 miles of line aside from the secondaries. We will build lines to Bakersfield, Maricopa, the Midway and down the West Side from the new power plant in Crane Valley. Following this we will rush our power line to Merced. Then we will provide power for the Kings River quarry. We next will prepare to extend the power line from Merced falls to Exchequer to supply the rock crushing plant there. Steps will be taken as well to provide power for the Santa Fe rock crushing plant on the Kings River. Power will be supplied, before all our plans are completed, to the Kern County oil fields by way of Bakersfield." E. L. Haines, electrical engineer in the San Francisco office of the J. J. White Co., the concern in charge of the construction of the new Crane Valley power plant, is in Fresno consulting with General Manager Wishon as to the best route for the prospective power lines. A full set of estimates for the route is being made out.

TRANSPORTATION.

STOCKTON, CAL.—The street railway employes of Stockton employed by the Central California Traction Company have been granted an increase in pay of 2c per hour.

LOS ANGELES, CAL.—Residents in the north and northwestern part of the city have petitioned the Council to offer for sale a street railway franchise through the North Broadway tunnel.

WHITE SALMON, ORE.—The survey for the base line of the Mt. Adams Electric Line has been completed and the engineers are now making the permanent survey which will determine the actual cost of the system.

SACRAMENTO, CAL.—In order to assure adequate street car service to the people of Sacramento and the thousands of visitors who will be here during the Fiesta of the Dawn of Gold and the State Fair, Charles W. McKillip, local manager of the Sacramento Electric, Gas & Railway Company, is making special efforts to get extra cars from outside points for use on the lines here while the festival is in progress. It is more than likely that McKillip will obtain cars from the Ocean Shore Railroad, which is not now operating.

LONG BEACH, CAL.—The Richards Neustadt Co., of Los Angeles, has been given a contract to complete a reinforced substructure for the Southern California Edison Company's power plant at the harbor. The cost of the work will be $89,000.

LOS ANGELES, CAL.—Electric car service of the Pacific Electric Railway Company between Los Angeles and El Monte is to be improved. The Covina line is double-tracked as far as El Monte and rest of route will be rushed. The grade was originally made for two tracks.

OAKLAND, CAL.—Frederick Brooks, construction engineer for the Oakland & Antioch Railroad, has announced that during the early part of the coming month rails will be laid from Walnut Creek to Bay Point. That having been done, work on the Concord-Martinez branch will be undertaken and extended to Lafayette.

LOS ANGELES, CAL.—The North, Northeast and Northwest Improvement Association has asked the Council to reconsider its action in refusing a franchise to the Los Angeles Railway Company on Ann and Alpine streets. The association declares the transportation service could be better if this franchise were granted.

LOS ANGELES, CAL.—Members of South Hoover and West Vernon Improvement Association will hold an important meeting next week. A resolution to offer for sale a franchise for an electric car line in Vernon avenue to connect southeastern and southwestern sections of the city is to submitted to the City Council.

UPLANDS, CAL.—The Pomona Board of Trade Committee having in charge the completion of raising of funds required to provide free right of way for the Pacific Electric Railway from Claremont city limits west and southwest into Pomona, has successfully completed its work. Money is pledged and ready to be paid to W. G| Kerckhoff on condition that road is built and completed between that city and Claremont and Upland by January 1st. It is stated that the company will commence construction work soon in an endeavor to have the road completed early in December.

SACRAMENTO, CAL.—The new Central California Traction Company started interurban service between Sacramento and Stockton Monday, August 29th. A party consisting of Alden Anderson, president of the new road; George W. Peltier, vice-president; Samuel Napthaly, directing engineer; Frank C. Miller, chief engineer and superintendent of operation and J. H. Leary left the Sacramento terminus at Eighth and I streets Sunday afternoon for a trip of inspection. With the third rail system completed the regular two-hour schedule between Sacramento and Stockton will be inaugurated. The 30 new cars which the company will place in operation on the interurban service have a carrying capacity of 60 people.

SANTA MONICA, CAL.—Practically every wheel of the Los Angeles Pacific Railroad was tied up August 29th and all traffic between the beaches and Los Angeles was interrupted through the walkout of twenty men who operate the seven transforming power stations along the route. They quit work because of the refusal of the company to give attention to their request of an increase in wages from $85 to $90 a month. Thousands of persons who live at the beach and work in Los Angeles were prevented from reaching the city for many hours. Automobiles and carriages were brought into requisition and brought fancy prices. Later the men returned to work upon order of General Manager Sherman that they all would be discharged unless they were at their posts within half an hour. Sherman says he will investigate the wage question of the men later.

HANFORD, CAL.—Work on the Hanford and Summit Railroad, an electric line 18 miles long, running between Hanford and Summit Lake, a settlement in the Kings river delta, was commenced at Hardwick this week and the expectations are that it will be completed within 90 days. The railroad will cost about $500,000 and is being built under the supervision of John B. Rogers, chief engineer and general manager of the company, and chief engineer of the Ocean Shore Railroad. The officers of the railroad company are Charles King, a Hanford capitalist, president; Ralph W. Heins of Santa Cruz, vice-president; L. L. Hickman, president of the First National Bank of Hanford, treasurer; George C. Aydelotte of Hanford, secretary; John B. Rogers of San Francisco, chief engineer and general manager; Clifford McClellan of San Francisco, general counsel.

RIVERSIDE, CAL.—H. E. Huntington intends to make Riverside division headquarters for his Southern California Interurban system. Deeds have been filed here disclosing the purchase by the Pacific Electric Land Company of a 100-foot strip along First street, between Main street and Colton avenue. The price paid was $30,000. It is said to be the intention of the company to lay a 4-track line on this right of way. Plans are being prepared for an assembling station, car barns and offices at the intersection of Main and First streets, where the company has an entire block of land. The architecture will be of the mission type. A half million dollars will be expended in trolley developments in this section during the next year. The company is also engaged in securing rights of way for a line to parallel the line now connecting this city with Crestmore and which is being extended toward Bloomington and Rialto.

ILLUMINATION.

TACOMA, WASH.—The city has passed an ordinance to provide for the construction of an electric substation upon the Fifth Addition, to cost $104,000.

EUGENE, ORE.—H. M. Byllesby & Co. are spending $25,000 at Eugene in extending mains. They are figuring on adding a water-gas set to the gas plant.

GREENVILLE, CAL.—The Indian Valley Electric Light & Power Company, which has established a plant in this town, proposes to extend its service to Crescent Mills and Taylorville.

LOON LAKE, WASH.—Gherke & Sons of the Gherke Mill Company, are planning for the installation of a light and water system for this place. It is proposed to have the plants completed by May 30, 1911.

COQUILLE, ORE.—F. Norse, proprietor of the Coquille Electric Company, has returned from a trip to Portland, where he arranged for the purchase of a complete electric lighting plant which will be shipped to this city and in working order by the first of October.

LOMPOC, CAL.—A proposition has been made to the citizens of the city through their representatives in the Town Board of Trustees by the Electric Light & Power Company, now supplying the city, to sell their plant to the city free of indebtedness for $27,500. If plant is purchased it will have to be enlarged.

ESCONDIDO, CAL.—The Escondido Utilities Company since being taken over by C. C. Glass, is planning to furnish power and electric light to Twin Oaks, San Marcos and San Pasqual valleys. The cost of carrying electricity to these valleys of course would be heavy and in order to do this it would be necessary for people of these valleys to subscribe to stock of the company.

VENTURA, CAL.—Lively opposition failed to defeat the lighting bond proposition on Ventura avenue last week. By a majority of three votes the citizens of the avenue decided to tax the district to maintain a lighting system. It required but a majority to carry a proposition of this kind and the vote of 29 for and 26 against shows by how close a margin the bonds pulled through.

CRESCENT, ORE.—Surveys are being made preliminary to plans for an electric light and power plant at this place by Engineer Gould and party of Bend. The company, which has filed on a power site in the reserve a half mile north of town, is composed of Albany capitalists, at the head of whom is Dr. N. E. Winnard. It is the intention of the company to erect a dam in the canyon where the head of the Deschutes narrows to about 60 feet. More than 5000 h.p. can be developed here.

ALAMEDA, CAL.—Two thousand eight hundred and eighty-seven residents of Alameda patronize the municipal electric light plant, the total earnings of which for the last fiscal year were $109,937.81, against a total cost of production of $67,789.03, leaving the net earnings of the plant $42,-148.78. Included in the total cost of production is $13,-414.52, allowed for interests,, taxes and depreciation. There was a gain of 397 consumers for the fiscal year. About three-fourths of the residents of Alameda are patrons of the municipal plant. The plant has under consideration a bid from the Great Western Power Company to supply the city with electric current for day service. It is the opinion of the electric light commission that the current can be purchased at a lower rate than the cost of operation of the plant.

NORTH YAKIMA, WASH.—Manager A. S. Grenier of Portland was here a few days ago with Superintendent Arrowsmith looking over the intakes of the power plant on the Naches river, with a view to improving and extending the service. Mr. Grenier said, in an interview, that he did not know how much additional water-power the company could get if it wanted it, and hence was unable to make any statement as to the probable increase of the power plant in the Naches. The result of the inspection trip will probably determine largely the needs of the company. Mr. Grenier also stated that the company is now reviewing engineers' plans for an increase in the size and capacity of the gas plant. The present one, he said, which was built for a town smaller than North Yakima, is operating to its capacity, and a probable doubling of the size of the plant, to meet the demands of a city twice the size of the one it now serves, will be one of the company's next moves. The plans for the enlargement are all tentative, however, and will depend somewhat also on the increase of power which is being sought.

WATERWORKS.

BANDON, ORE.—The Council has decided that an engineer be employed to run levels to the new water reservoir and that a map be made of same and submitted to the state engineer.

LIBBY, MONT.—A waterworks system is assured for Libby. Arrangements are now under way to put in a municipal plant should the Great Falls people who are figuring on taking the franchise fail to begin operations within a reasonable time.

COLFAX, CAL.—The South Yuba Water Company is about to commence the laying of new mains and laterals here. Since building the large reservoir east of Colfax this place has an excellent water supply and the laying of new mains means better fire protection.

SPOKANE, WASH.—The Council has passed an ordinance authorizing and directing the Board of Public Works to enter into a contract with the Baker-Stearns Company for water mains in Mount Pleasant First Addition. The agreement shall provide that kalsomine pipe only shall be laid, that valves and hydrants be placed as shown on plants.

ALBANY, ORE.—A communication from the Northwestern Corporation has been presented at the Council and read, relative to the prospective extension of the water system in the eastern part of the city. The expenditure is estimated at $15,000. In the communication the corporation offers to make the improvement if the city will enter into a contract for 33 additional fire hydrants, and 30 more arc lights for a period of ten years. The communication has been referred to the committee on ways and means.

RED BLUFF, CAL.—J. W. Ivey is in this city making estimates for a water elevating pumping plant for irrigation purposes and obtaining rights of way for the proposed canal. The company represented by Ivey recently appropriated 80,-000 inches of the water of the Sacramento river and proposes to divert 5000 inches to irrigate farms in the Antelope valley.

TACOMA, WASH.—The Council has passed an ordinance providing for the construction of water main of six-inch cast iron on Melrose street and South Fifteenth street from Junett street to Cedar street and on Cedar street from South Fifteenth street to South Fourteenth street, according to plans and specifications prepared and filed in the office of the Commissioner of Light and Water.

OAKLAND, CAL.—Rights of way for pipe lines extending from near Centerville to Dumbarton Point have been granted to the Spring Valley Water Company by the Southern Pacific Company. The rights of way vary from 18 to 25 feet in width and follow the line of the Southern Pacific. At Dumbarton Point, where the rights of way end, the Spring Valley Company has a conduit under the bay by which it carries water to San Francisco.

SAN RAFAEL, CAL.—The Marin Water & Power Company has broken ground on the new dam site at the head of Fairfax grade. A force of men have been at work for some days under the management of Superintendent Barr. The concrete base is expected to be laid before the winter season sets in. The base of the dam will be 650 feet in length and the dam will be 100 feet in height and will be built of solid masonry and will have a capacity of 3,500,000,000 gallons.

WOODLAND, CAL.—The Yolo County Consolidated Water Company, whose stockholders are Yolo County capitalists has secured all the rights and interests of every irrigation system in the county, and has contracted to sell the entire property of the corporation to Lieutenant-Governor Warren Porter of Watsonville, J. W. Forgeus and others. The sale is outright and the deal will be closed as soon as an agreement is reached between the landowners adjacent to Clear Lake and the purchasers in regard to raising the level of the lake so that an unlimited supply of water for irrigating purposes and power may be assured. Most of the land owners have signed the agreement already. There will be enough water to irrigate all of Yolo and a large part of Solano County. The water will follow a creek bed for many miles, saving the expense of canal work. The present company irrigates thousands of acres with the natural flow of this creek.

OAKLAND, CAL.—In a report to the Council J. H. Dockweiler, city water expert, made known the fact that the People's Water Company had practically completed its new central reservoir, which is being constructed to meet the demands for water storage facilities. It will be ready for receiving water at the end of the present month. Nothing remains to be done but the trimming and dressing of the slopes, and the work on the concrete parapet. Dockweiler's report gives the receipts and expenditures of the water company for the six months ending June 30. The total receipts for that period, including money received for general water rents, tapping, turn on and land rents, amount to $451,315.87. The expenses, including supply and distribution, maintenance, general expenses and service construction, amounted to $147,861.15. The receipts over and above the expenses amount to $303,454.72. The taxes were $38,878.76, and the net receipts were $264,-575.96. Under the head of construction expenditures comes the central reservoir, $55,553.97; piping and street mains, $61,719.23; sundray acounts, $41,929.29, a total of $159,202.49.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 11 SAN FRANCISCO, SEPTEMBER 10, 1910 PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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VOLUME XXV | SAN FRANCISCO, SEPTEMBER 10, 1910. | NUMBER 11

N. W. ELECTRIC LIGHT & POWER ASSOCIATION

Delegates N. W. Electric Light & Power Association on Steamer Queen.

The third annual convention of the Northwest Electric Light and Power Association was held August 26-29, 1910, on board the steamer Queen, which encircled Puget Sound during the course of the meeting. Such a meeting place is unique in Pacific Coast annals and contributed greatly to the success of the convention, not only in improved attendance, but also in an excellent opportunity for the members to become well acquainted. About eighty members were in attendance, together with the wives constituting a party of about one hundred and thirty.

The members and guests assembled on board at Seattle, Friday evening, August 26th, and arrived at Tacoma early Saturday morning. Here they took sight-seeing cars placed at their disposal by the Tacoma Railway and Power Company, returning in

time to attend the first business session on Saturday afternoon.

This was opened with an address by President Arthur Gunn, president of the Wenatchee Valley Gas and Electric Company, who introduced W. J. Grambs as the author of the paper on "Rate Making," published elsewhere in this issue. Following the discussion on this paper, the convention went into executive session for consideration of the subject of legislation.

On Saturday night a dance was held at the Hotel Tacoma, the steamer thereafter proceeding to Everett.

No business session was held on Sunday, the day being devoted to rest and recreation. A number of neophytes were initiated into the "Order of Neptune," incidentally receiving an unexpected salt water bath. At a subsequent mock trial A. H. Buck, president of the Monroe Water and Light Company, was convicted of the heinous offense of selling electricity at 3 cents per kw. hour, his only defense being that his cost of production from saw-mill refuse justified the procedure. He was adjudged guilty of lunacy and sentenced to the Steilacoom Insane Asylum.

The party reached Vancouver about 8 o'clock Sunday evening, being there met by a delegation from the British Columbia Electric Railway Company, including Chas. Rummel, manager of the light and power department, W. T. Woodroofe, superintendent of the railway department, and H. E. Grant, illuminating engineer, who, together with D. R. Kennedy, superintendent of transportation and generation, and G. D. Robinson, of the engineering department, escorted the party on sight-seeing cars throughout the city. A fire alarm was turned in so that the visitors might see the electric-driven chemical engine.

Early Monday morning tally-hos took the party through the more beautiful parts of the city, the party disbanding at the Vancouver Hotel and proceeding thence to the boat. The reception tendered by the British Columbia Electric Railway Company was most hearty and was greatly appreciated by the visitors,

Monday afternoon A. C. McMicken read a paper on "Methods of Obtaining Business," as published in these columns of September 4, 1910. After discussion on this paper, D. L. Huntington's paper on "Depreciation" was read by Secretary Brockett in the absence of the author. This paper appears elsewhere in these columns. Arthur Gunn also read a paper on "Employers' Liability." The steamer meanwhile continued to Bellingham and thence to Seattle, where the meeting adjourned on Tuesday.

At the executive session on Monday evening officers were elected for the ensuing year.

Douglass Allmond, of Anacortes, is the new president of the Association, H. V. Gates, of Heppner, is vice-president from Oregon, F. Shields, of Moscow, vice-president from Idaho, Norwood W. Brockett, of Seattle, secretary and treasurer. The executive committee consists of M. D. Spencer, of Eugene, J. S. Thornton, of Aberdeen, and L. B. Faulkener, of Olympia, the latter being re-elected.

Exhibits were made by the Westinghouse Electric and Manufacturing Company, the Western Electric Company and Allis-Chalmers Company.

The entire meeting was voted a great success, resolutions of commendation attributing much to the energy of Secretary Brockett.

DEPRECIATION.[1]

BY D. L. HUNTINGTON.

Depreciation is now receiving the attention from all conservatively managed operating companies which it fully deserves. While opinion is still quite diverse as to the extent of depreciation and the methods of arriving conservatively at proper charges, nearly all companies are making some allowance in this direction. This has been brought about not only by the unavoidable realization, as the years go by, that such a charge must be provided for as a cost of operating the property, but closer attention has been drawn to the matter in the last few years through the growth of public service commissions which have undertaken the supervision and regulation of the rates charged; especially where rates have been regulated downward, a closer scutiny of items entering into the cost of service has brought the fact plainly to view that such charges must be included in the cost of operation.

Depreciation accounts in themselves must of necessity partake of the nature of estimates, and such estimates may vary widely one from another even on the same property through difference of opinion as to the nature of depreciation, the length of life of apparatus, and other considerations. Three methods of arriving at depreciation charges have come to the writer's attention.

First: Some properties arrive at the depreciation charge by taking the difference between an arbitrary percentage of their gross receipts and the amount charged for maintenance. This is an easy method, but has nothing special to recommend it excepting the fact of the facility with which the figures can be arrived at. It has no logical basis, and will undoubtedly not long continue.

Second: Other concerns have gone into the most elaborate determination of depreciation items, taking each piece of apparatus and each installation as it is made and opening a separate depreciation account for each such item, and extending the depreciation charge yearly for each such item, totalizing in order to arrive at the whole depreciation of the property. This method is probably more nearly accurate theoretically than any other method which has been used to any extent, but has the disadvantage of being extremely cumbersome, requiring a great deal of clerical and engineering labor and skill in its preparation.

Third: This method consists of taking the plant as a whole, grouping the various classes of apparatus, machinery, buildings, etc., into classes which are arbitrarily assumed to have about equal rates of depreciation. From these figures on the plant as a whole the charge for depreciation is arrived at. It is then determined what percentage of the total investment should thus be written off. This percentage may then be applied for several years to the property as it grows, when the whole process should be repeated with a view to determining whether any material change in the percentage thus arrived at has taken place, and a new percentage assumed for another period of years. This system does not entail anything approximating the labor and clerical force required by the second plan outlined above, and yet it has a

[1] Paper presented at convention N. W. Electric Light and Power Association, Seattle, Aug. 26, 1910.

logical basis which does not exist in the first plan mentioned, and it seems probable that it is along such lines that depreciation estimates will be arrived at in the future.

In determining the percentage of depreciation for application to the plant as a whole many factors must be considered. In the first place the actual life of machinery, apparatus, buildings, etc., should be determined as accurately as experience will permit. Second, the rate at which such properties become obsolete, regardless of their actual serviceable life, should be determined. For instance, a machine may be carried through a long period of time, perhaps twenty or twenty-five years, and by judicious repairs and maintenance, be kept in almost as good condition, as far as service is concerned, as it was at the time of its installation. Long before the period of its useful life as a serviceable machine has expired it may become obsolete to such an extent, on account of changes of methods, new discoveries, size of units, efficiency of apparatus, etc., that it becomes a useless burden upon the system, and must be discarded as an asset for that reason. This feature of depreciation is, in all probability, the most difficult one to determine upon, and one upon which there will be greater difference of opinion than on almost any other portion of the depreciation item, for the reason that it requires one's judgment as to what the future development of the business may be five, ten or even twenty years later.

Another consideration of importance upon which there would be difference of opinion, is as to what provision should be made with regard to the expiration of franchise rights. Shall it be assumed that we can safely expect a renewal of our franchises or public rights at their expiration, upon terms sufficiently reasonable to enable us to go on with our business, or must we assume that at the expiration of our franchise we must have placed ourselves in a position where we have retired the investment which has been made for the purpose of doing business under such franchises? I think that the managers of most properties will arrive at the conclusion that this franchise expiration feature will have to be largely eliminated from the question, and that it will have to be assumed that such properties will be continued in operation under new franchises or agreements with municipalities, or public service commissions, which will permit their proper and profitable operation.

In determining the total depreciation of the property of a company consideration must be given to the value of real estate, water power rights, freight and passenger terminal lands, for the reason that they may not only not depreciate, but they may, and probably will, in most communities, show an actual, and perhaps a very large, appreciation in value, and these should be taken as an offset as against the depreciation charges otherwise arrived at.

In general a carefully managed property will charge off to depreciation a sum which is conservatively sufficient to meet the purpose for which it is made, as any other course will, in the long run, where prices are close or competition is keen, lead to financial disaster, and it is much better to make, apparently, a showing somewhat less satisfactory on our books, and in our statements to our stockholders, than might possibly be justified by a less conservative statement, than to run any material risk that at some future time we will have to show to our stockholders a condition of impairment of capital.

The purpose of this brief paper is merely to outline in general a few ideas on the subject, with a view more to stimulating discussion and bringing out the ideas of other persons, than to lay down any rules or dictum from the writer's standpoint. It is sincerely hoped that the subject will receive the earnest consideration which it deserves, and that a very full discussion of the matter will take place, which cannot help leading to a better understanding of one of our most serious financial problems.

NOTES ON RATE MAKING.[1]

BY W. J. GRAMBS.

Electrical energy for light and power should be considered a service rather than a commodity. It cannot be stored up like gas, and the generating plant may be called upon any time to furnish the maximum demand of a consumer's installation, although this may happen only occasionally. The central station must therefore prepare to meet the consumer's demand by installing an equal amount of generating apparatus.

The proper method of arriving at rates for electric light and power current has been the subject of much discussion, and various forms of rates and schedules have resulted. Local causes and influences greatly vary the results obtained by different companies, and the actual rates vary in different localities, but the underlying principles on which the rates are based should be the same.

Flat rates are objectionable because short hour consumers are compelled to pay as much as long hour consumers for the same load, and in addition to this, flat rates lead to wastefulness.

A straight meter rate is satisfactory only where all consumers use electricity in the same way and under similar conditions. Such a rate, however, is as unfair and unwise as it would be to require a uniform rate for all classes of freight.

The plan of getting what you can in competition leads to various rates for exactly the same class of service, and eventually to financial ruin.

The quantity discount plan, where a specific rate is given for each class of service, and then step by step discounts made for quantity used, is a step in the right direction, though only a partial solution of the problem.

The "two-rate" or primary and secondary rate scheme, and the readiness-to-serve scheme, based on maximum demand, can combine practically all of the features which go to make up an equitable rate.

One of the things which restricted central station progress for years was the failure to recognize the great difference in the cost of serving different classes of consumers. There is no discrimination when a rate automatically gives a lower rate to a consumer because of greater hours of use per day of electricity, when such rates are open to everybody and depend entirely on the class of service demanded.

[1]Paper presented at Seattle Convention N. W. Electric Light and Power Association, Aug. 26-29, 1910.

A theoretically correct rate, i. e., one which will divide the cost and profit equitably between all consumers, would be extremely complicated, and would cause dissatisfaction not only on account of it not being generally understood, but on account of certain other features, among which might be mentioned the following:

(a) Very short hour users would pay an extremely high rate per kilowatt hour.

(b) Location of customers as regards point of generation would have to be taken cognizance of on account of difference in line losses.

(c) Large consumers would have to pay a rate which would increase isolated plant competition.

A high rate for short hour users, while justifiable, has been found to be impracticable, and is conducive to rate regulation by civic commissions.

Variation in rate on account of locality has likewise been found not to be good policy.

Large consumers must be given a price only slightly in excess of what they can furnish the same service for themselves, which may be somewhat less than the ideal equitable rate.

Now, since it is not practical to charge the short hour user and the large consumer at the theoretically correct rate, the additional profit must be made on the intermediate consumers.

In making up or revising rates it is always best to determine the theoretically equitable rate for each class of consumer and to vary this as occasion demands.

In making up this theoretical rate for each class of service there are four general divisions of expense to be taken into account, and which go to make up the total cost to the consumer, to wit:

(1) A consumer's charge.

(2) A capacity charge or (a) fixed charges based on the generating plant and (b) fixed charges based on the distributing system, which included converting and regulating apparatus, lines, transformers, etc.

(3) An output charge.

(4) Profit.

The consumer's charge should cover cost of reading meters, collecting, billing, and all costs which vary with the number of customers, and is usually arbitrarily fixed at $1.00 per month.

The capacity charge should cover bond interest, general salaries, general expense, and all other items due to the capacity of the station and distributing system.

The output charge should cover operating supplies, fuel, oil, waste, labor, and all expenses depending on the output of the station, and profit.

The fixed charges on the operating plant should be divided among consumers in direct proportion to the consumer's effect on the peak load, whether they be ligh[illegible] or power customers. To divide this, what is generally known as "diversity factors" must be obtained between the consumer's service and the generating station. If this diversity factor is known, or can be found, the division of fixed charge on plant can readily be made.

The fixed charges on the distributing system vary in general with each class of customer, and for residence lighting forms the largest part of the cost. For large power customers it becomes only a small portion of the cost. The fixed charges on the distributing system cannot be divided in proportion to the amount each consumer's current is to the total current in the lines at peak, or at any other time, but must be found for each class of service separately.

The short hour consumer will automatically pay a higher rate and the long hour consumer a lower rate, and the longer the use each day the lower the rate and there will be no overlapping points as in many of the discount and step rates. Such a rate will be approximately correct and be equitable to all concerned. The rate will discriminate between profitable and unprofitable consumers and will make all bills more uniform throughout the year by lowering the winter bill and increasing the summer bills.

After the theoretical rates have been determined by an analysis of costs in conformance with the above, then the rates should be made as simple as possible so that the customer can readily understand their application to his load.

Residence Lighting Rates.

While it is true that a consumer's load factor should determine his rate, the difficulty and expense of getting such data in the case of residential lighting would suggest some simple schedule readily understood by the consumer and which will insure a fair return to the central station. The diversity of residence lighting is such that the maximum demand of various consumers does not correspond. The residence peak will last from three to five hours and does not, as a rule, come on until after the commercial power load is off. There is no doubt that the cost of carrying the small residence consumer is abnormally high, due to meter and transformer costs and changes, accounting and collection costs, and it is therefore proper to make a higher rate for residence service. The residence consumer, in spite of his relatively large occasional demand the general expense he entails, has one compensating virtue in that his peak does not, as a rule, add itself to the general peak but follows it.

All maximum demand schemes tend to discourage domestic use of electricity. In order to determine the maximum demand in a residence it has been the practice to assume the maximum demand to be from 30 to 50 per cent of the consumer's connected load, maximum demand meters being too expensive for this class of lighting. This puts a penalty on numerous convenient lamps in closets and other out of the way places which are only occasionally used. An assessed maximum demand is undesirable because of the frequent change of lamps in a residence, and unless a frequent check of the service is made there will be a great inequality in the rate which a consumer will get from time to time.

The consumer having a good load factor and the one having a large demand should both have a concession in rate—the first on account of reductions in generating plant fixed charges per kilowatt hour—and the second on account of reduction in general expenses and distribution of fixed charges per kilowatt hour.

Power Rates.

Power rates should be based on the same general principles that light rates are based upon in order to

be equitable. The fixed charge must be distributed in proper proportion among the various consumers so that each customer pays fixed charges on the capacity of the plant required to serve him, after which the rate should distribute the operating expense and profit among the customers. Power should be charged for on the average peaks of the consumers upon the generating station rather than by the individual peaks of the different consumers, which will as a rule occur at other times than during the peak of the station. As a matter of fact, the maximum demand of power customers will usually occur during the light period of the day, and due to the diversity of the load, these peaks coming at different hours of the day make it possible for the station to handle the load more economically. There is also a diversity of load between power and residence lighting, because as the power load goes off at the end of the day the residence load comes on. Power for small consumers can usually be furnished by electric light companies without substantially increasing the investment. The price must be low enough to make the service attractive, and it cannot be sold to the consumer much in excess of what it would cost him to make it. The rate must be simple, but it should be fixed and variable expense.

The Commonwealth Edison Company, of Chicago, determined the percentage of maximum demand to the connected of about four thousand motor customers to be as follows:

Installations under 10 h.p. 1 motor used........	85%
Installations under 10 h.p. more than I motor used	75%
Installations of from 10 to 50 h.p. irrespective of number of motors used	65%
Over 50 h.p. irrespective of number of motors used	55%

Owing to the diverse character of load and the different hours of maximum demand, the connected load may be two or three times the station capacity.

Wholesale Power Rates.

Wholesale power rates should carry a primary charge or guarantee based on the maximum demand and load factor, plus a secondary kilowatt hour rate based on the variable expense and profit. It is difficult, however, to establish a system of rates based on one primary and one secondary charge because of the fact that it costs proportionately more to serve a small consumer than to serve a large consumer, and also because the cost of making current during long hours per day is less for the same demand than it is where the service is for short hours per day.

The effect of competition by other public service corporations will have an effect not only on the form of rates or the general rate plan, but on the actual rates themselves. As an example, the Municipal Plant of Seattle, which also does a large commercial business, will quote a rate to a customer who uses his power for twenty hours per day or longer so low that The Seattle Electric Company could not possibly take the business and make a profit. On the other hand, The Seattle Electric Company has been able to take business away from the municipal plant and make a good profit when the customer only uses his power from eight to ten hours per day.

With competition of this sort any lack of return from long hour business must be made up on the shorter hour business, and the schedule must be made up accordingly.

Competition should be met by improvement in service, and by a schedule of rates designed to fit your own and your competitor's costs.

Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, read a paper before the N. E. L. A. at St. Louis on the effect of high efficiency lamps on the cost of light to the central station. The paper was listened to with a great deal of interest, and I have taken the liberty of presenting Mr. Doane's paper herewith in an abbreviated form in the belief that you will all be interested in what he said, as follows:

"Dr. John Hopkinson, F. R. S., in 1892 established a broad principle that was recognized and accepted by the electric light industry as correct, which divided costs of current into fixed and operating classifications."

"Henry L. Doherty in 1900, in a paper read before the National Electric Light Association, worked up the same idea and further divided the fixed cost into two sub-divisions—and Mr. Doane in his paper worked along the lines indicated by Mr. Doherty. He consulted central station men of much experience from all parts of the country, and a number of men from his staff were employed for a period of two years collecting and working up the data upon which he bases his deductions."

In discussing the effect of the high efficiency lamp on central station costs his analysis and arguments were based on the following premises:

1st. The discussion was limited to the lighting load.

2nd. In order to obtain a fair average the analysis cover a period of at least one year.

3rd. The station capacity of the various plants is considered not greatly in excess of the maximum demand.

4th. The items of outgo, such as dividends, interest, depreciation, obsolescence, and all losses, are as much items of cost as the items of coal, labor, etc.

As a basis for his discussion he presented Table I —the result of a careful cost analysis of a number of central stations. The percentage distribution of the total cost under the items "General Expense," "Distributing Expense," "Generating Expense," etc., is shown separately for each of the four cases represented in the column headed "% of Total Station Expense."

Each of these items was further analyzed and distributed by percentage under one or more of the headings as shown in the last three columns of Table I. The proportion of each item charged to "Output" represents the relative proportion of the cost which depends upon cost per k.w.h. The proportion of each item charged to "Demand" represents the relative proportion of the cost that depends on the capacity of the plant, which in turn depends upon the "Demand." The portion charged to "Consumers" represents the relative proportion of the cost which depends upon the number of consumers connected and served.

TABLE 1.

Central Station Cost Analysis.

Item		% of Total Station Expense	% Item Output	Proportional to Demand	Proportional to Consumers
General Expense	a	12.7	....	75.4	24.6
	b	14.5	....	71.0	29.0
	c	10.2	....	82.8	17.2
	d	10.9	....	80.0	20.0
	Weighted average	12.0	....	76.9	23.1
Distributing Expense	a	15.2	50.2	26.4	23.4
	b	9.7	44.7	21.4	33.9
	c	17.8	50.6	24.7	24.7
	d	12.8	31.8	56.9	11.3
	Weighted average	14.4	47.0	28.9	24.1
Generating Expense	a	13.4	80.7	19.3	....
	b	17.7	74.6	25.4	....
	c	32.1	70.3	29.7	....
	d	32.3	67.9	32.1	....
	Weighted average	23.9	72.0	28.0	....
Taxes and Insurance	a	8.1	....	80.0	20.0
	b	10.9	....	86.2	13.8
	c	6.8	....	85.9	14.1
	d	4.4	....	80.0	20.0
	Weighted average	7.8	....	84.0	16.0
Depreciation	a	11.6	....	80.0	20.0
	b	11.5	....	79.5	20.5
	c	9.0	....	85.9	14.1
	d	6.0	....	80.0	20.0
	Weighted average	9.8	....	81.8	18.2
Interest and Dividends	a	39.0	13.1	68.1	18.8
	b	35.7	27.2	55.1	17.7
	c	24.1	26.4	61.4	12.2
	d	33.6	8.9	73.7	17.4
	Weighted average	32.1	19.7	63.7	16.6
Total..........	a	100.0	23.5	58.5	18.0
	b	100.0	27.2	55.1	17.7
	c	100.0	37.9	50.8	11.3
	d	100.0	28.9	59.5	11.5
	Weighted average	100.0	30.3	55.1	14.6

"a" Represents a large Central Station giving free renewals.
"b" Represents a large Central Station giving free renewals.
"c" Represents the average of about 70 Stations in the East.
"d" Represents the average of about 40 Stations in the West.

In the table each item of cost has been listed under fixed or operating cost, or has been divided and party listed under fixed or operating costs. Fixed costs have been divided into "Demand Costs" and Consumers' Cost."

The "Demand Cost" covers the cost involved in supplying the maximum demand, and a proper allowance was made for diversity factor in arriving at this cost.

The "Customers' Cost" for the average customer is a cost which an individual customer causes, whether or not he actually consumes any current.

The following rule was applied to determine the cost divisions:

If the analysis of any cost showed that an increase of 100 per cent in the number of customers, without the total output or total demand necessarily being increased, would presumably double the expense, such as reading of meters, it was taken as an item which varied directly with the number of customers and was classed as 100 per cent "Consumers' Expense."

If an item of cost would be doubled with an increase of 100 per cent in capacity of the plant, even though the number of customers remained the same, such an item was classed as a "Demand Expense." In a similar way items would be classed under "Output."

Mr. Doane believes that the percentages given in his table are conservative, and that they indicate, at least, the nominal cost at which a new customer can be added to the system on the present basis.

Every customer, no matter how small, must have a pair of wires and necessary poles, fixtures, etc., to bring wire to his premises—he must have a meter and demands some attention in the way of meter reading inspection, billing, etc. Consequently, he costs the central station a definite minimum amount per year although he uses no current whatever.

Mr. Doane then proceeds to discuss the effect of high efficiency lamps on the cost of serving the central station average customer, after which he considers the effect of the high efficiency lamp in serving larger and smaller customers with larger and smaller load factors.

Taking the figures in Table I Mr. Doane plotted some diagrams which show the effect of the adoption of high efficiency lamps by a customer of 1.6 kilowatts maximum demand and 11 per cent load factor, which is about the average load factor for residence lighting in Seattle. The fixed customers' cost is indicated by the letter "C"—the total demand cost for 1.6 kw. maximum by the letter "D," and the total cost of the kw. h. actually consumed by the letter "O." The value of these representations for carbon lamps in Figure I is as follows: "C," 14.6 per cent; "D," 55.1 per cent; "O," 30.3 per cent of the total as shown for the average in Table I.

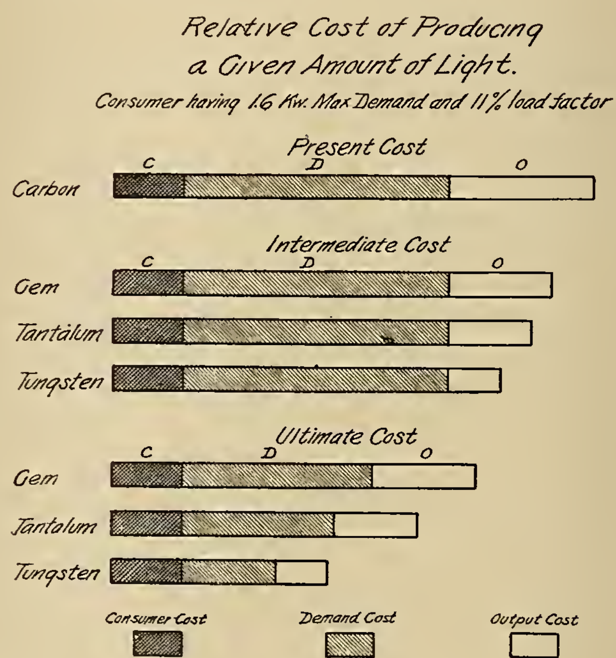

Fig. 1.

The first single rectangle in Figure I represents the cost of an average consumer with a maximum demand of 1.6 kw. and a load factor of 11 per cent burning carbon lamps. When this average customer changes to high efficiency lamps and obtains the same amount of light as before the result is shown in the middle group of diagrams. The longest parallelogram shows the effect of the cost when the gem lamp is adopted, the next the tantalum lamp and the third when the tungsten lamp is adopted. If no new customers are added the central station cannot reduce the customers or demand costs charged against the customer, and the sole reduction in cost is the reduction in kw. hrs. required to produce the same amount of light.

In this illustration Mr. Doane shows that the reduction of cost due to the adoption of the Gem lamp is 8.7 per cent, for the tantalum 13 per cent, and for

the tungsten 19.5 per cent, and, assuming that the tungsten lamp for a given amount of light only uses 1-3 the amount of current that the carbon lamp uses, the cost of light is only reduced by 2-3 of that portion of the cost which varies with the kw. hrs. The total cost reduction is, therefore, only about 20 per cent instead of 60 per cent.

Referring again to Figure 1, the lowest group of short rectangles shows what happens when the station has added enough new customers to utilize its output, all customers using high efficiency lamps. Under these conditions the cost of producing light for the average consumer with the tungsten lamp is reduced 55 per cent.

Figures 2 and 3 assume a customer of small size having a maximum demand of 0.5 kw. with load factor of 7 per cent and 20 per cent respectively. In the case of the consumer with 7 per cent load factor the cost of kw. hrs. is only 16 per cent of the total cost with carbon lamps, and about 6 per cent with the tungsten lamp.

The astonishing fact was developed that even such short hour burners with small maximum demands receive the full benefit of the tungsten lamp by adding enough customers to take up the entire capacity of the central station the cost of current consumed is only about 10 per cent of the total cost of carrying such a consumer. Even in the case of a comparatively long hour consumer, as shown in Figure 3, having a small maximum demand, the kw. h. consumed cost the central station but a very small part of the total cost for the customer. Most of the cost for a small consumer is due to supplying the service to the customer. The diagrams show that the high efficiency lamp reduces the cost of producing a given amount of light for the average small customer, but this reduction of

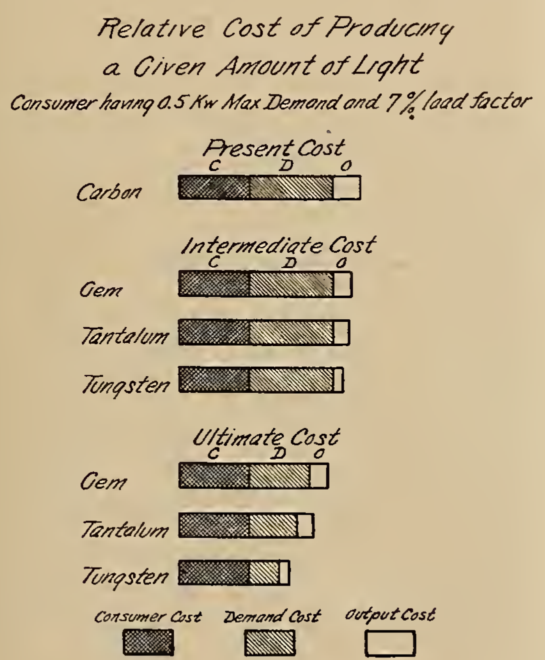

Fig 2.

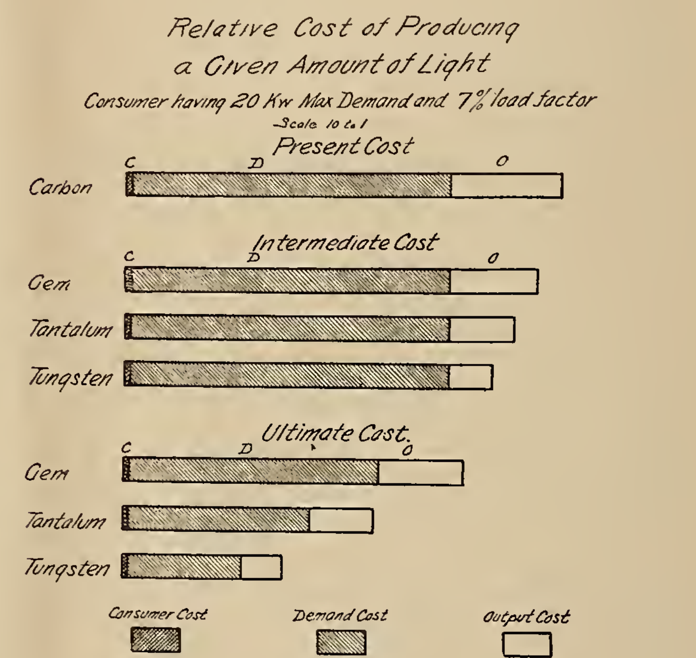

Fig. 4.

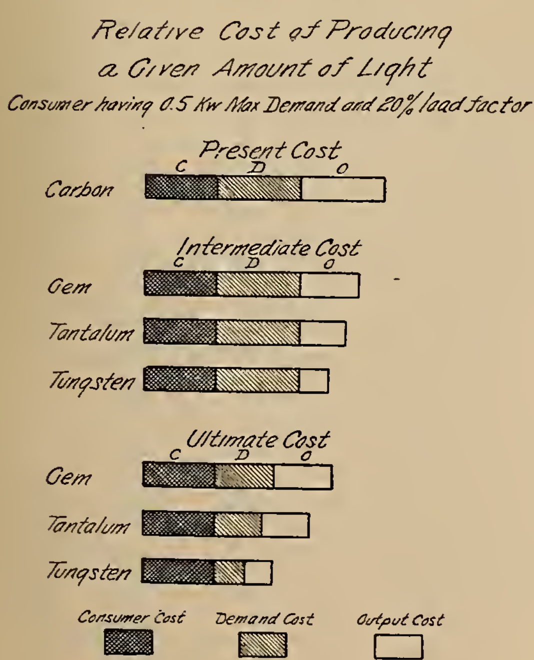

Fig. 3.

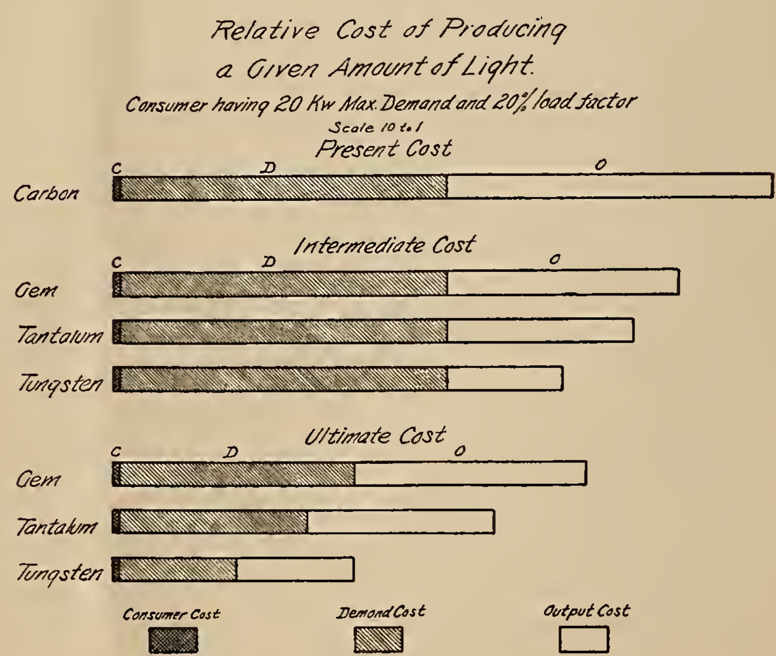

Fig. 5.

cost is in no sense comparable with the reduction in current required for a given amount of light.

Figures 4 and 5 show a large consumer, and it will be observed that the consumer's cost is a very small part of the whole. The reduction in cost due to the use of tungsten lamps by a short hour consumer is only about 15 per cent when additional new customers have not been taken on by the central station.

The following table gives a summary of the foregoing diagrams:

Table 2.

Relative Cost of Serving Customers.

Consumer	Present Cost Carbon	Intermediate Cost Gem	Intermediate Cost Tantalum	Intermediate Cost Tungsten	Ultimate Cost Gem	Ultimate Cost Tantalum	Ultimate Cost Tungsten
Average	100.	91.3	87.0	80.5	75.6	63.8	45.1
Small—Short hr.	100.	95.5	93.2	89.8	82.5	73.8	60.6
Small—Long hr.	100.	88.1	85.0	77.4	80.0	70.0	54.9
Large—Short hr.	100.	92.7	89.1	83.6	71.8	57.8	36.7
Large—Long hr.	100.	85.9	78.8	68.2	71.7	57.5	36.3

Consumer	K.W. Maximum Demand	Load Factor
Average	1.6	11%
Small—Short hr.	0.5	7%
Small—Long hr.	0.5	20%
Large—Small hr.	20.0	7%
Large—Long hr.	20.0	20%

Each consumer is assumed to use the same total amount of light before and after changing from carbon to high efficiency lamps.

TABLE 3.

Effect on Station Cost and Output Produced by Adoption of the Highest Efficiency Lamps.

(Assuming that each consumer produces the same amount of light with highest efficiency lamps as with the lamps of low efficiency.)

Number of Consumers in % of the number supplied at present with low efficiency lamps	Cost to Station: Consumer	Cost to Station: Demand	Cost to Station: Output	Cost to Station: Total	Kw-hrs. Consumed and maximum demand in % of that with low efficiency lamps	Relative Cost: *Per Kw-hr.	Relative Cost: Per Consumer
100% using low efficiency lamps	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Changed to the following per cent using highest efficiency lamps	14.6	55.1	30.3	100.0	100.0	100.0	100.0
100	14.6	55.1	10.8	80.5	35.7	225.0	80.5
110	16.1	55.1	11.9	83.1	39.3	212.0	75.5
120	17.5	55.1	13.0	85.6	42.9	200.0	71.4
130	19.0	55.1	14.1	88.2	46.4	190.0	67.8
140	20.4	55.1	15.1	90.6	50.0	181.0	64.7
150	21.9	55.1	16.2	93.2	53.6	174.0	62.1
160	23.4	55.1	17.3	95.8	57.2	168.0	59.8
170	24.8	55.1	18.4	98.3	60.7	162.0	57.8
180	26.3	55.1	19.5	100.9	64.3	157.0	56.1
190	27.7	55.1	20.6	103.4	67.9	152.0	54.4
200	29.2	55.1	21.6	105.9	71.4	148,0	52.9
210	30.7	55.1	22.7	108.5	75.0	145.0	51.7
220	32.1	55.1	23.8	111.0	78.6	141.0	50.4
230	33.6	55.1	24.9	113.6	82.2	138.0	49.6
240	35.0	55.1	26.0	116.1	85.7	135.0	48.4
250	36.5	55.1	27.1	118.7	89.3	133.0	47.5
260	38.0	55.1	28.1	121.2	92.9	130.0	46.6
270	39.4	55.1	29.2	123.7	96.5	128.0	45.8
280	40.9	55.1	30.3	126.3	100.0	126.0	45.1

*Please do not confuse this with the output cost per kw-hr. which remains practically constant throughout.

Table 3 shows in a general way what might be expected when all central station customers will have changed to tungsten lamps. This of course will not actually ever happen, but between now and that time each station will have increased its number of customers, and the table is made to include all percentages beginning with no increase and ending with 180 increase in customers, at which time the station will be entirely loaded again. The table is further based on the theory that the customer will not increase the amount of light he uses at peak. The table shows that the consumer's costs, which are the costs per customer for distributing the current generated, are the costs which concern the central station to a constantly increasing extent. The investment in meters and length of line necessary to reach a customer, etc., will be of greater importance to the station man than the efficiency of the generating apparatus.

The table further shows that when a station has added 80 per cent more customers than its total costs will again have reached the present cost with carbon lamps, and the cost per kw. h. will be about 60 per cent greater than at present. Mr. Doane in his paper brings out the following points:

The logical effect of the high efficiency lamp is to increase the number of small consumers. This means an increase in the proportion of the central station expense for labor in connection with the distribution system and accounting, etc., or consumer's cost.

The addition of many new customers will improve the load factor. The high efficiency lamps will enable the central station to greatly increase the number of customers without increasing the generating investment. The reduction in the cost of light can never be so great as the customer expects—he always associates the two-thirds reduction of current consumed with a two-thirds reduction in cost. The decrease in the cost of furnishing light will be measured by the ability of the central station to take on additional consumers who will assist in bearing the fixed expenses.

High efficiency lamps will be made more efficient and the central station must adopt policies that will not only take care of the present lamp situation, but which will provide for any increase in their efficiencies in the future.

Ductile tungsten is now being manufactured and tungsten lamps will be hardy and capable of satisfactory employment in residences and other places, so that ultimately nearly every customer of a central station will use the lamp.

ANCIENT MEXICAN WATER MEASURES.

The old Mexican standards for measuring water have long since been displaced by the metric system for engineering work, but the old nomenclature is still in use among the common people and is found in the old records and writings. These ancient hydrometric measures are as follows: 1 buey (ox), 48 surcos; 1 surco (furrow), 3 naranjas; 1 naranja (orange), 8 reales or limones; 1 real (bit) or limon (lemon), 2 dedos; 1 dedo (finger), 9 pajas (straws). According to the old ordinances of lands and waters established in Spanish times, the buey of water was as much as would flow through an aperture 1 vara (0.838 meter) square, no head pressure being mentioned. By a law of the Mexican Republic of August 2, 1863, 1 surco was equal to 6½ liters per second for rural measures, and the paja was made equal to 0.45 liters per minute for town measurements. This distinction was intended to make the surco a unit for irrigation, while the paja was made unit for distributing water to houses, etc., in towns.

CALIFORNIA FUEL OIL.

BY R. F. CHEVALIER.

Draft.

The term draft as employed in boiler practice refers to the difference in density or weight of the external air and the heated gases in the passes of a boiler or stack. Atmospheric pressure is due to the weight of the air. The pressure on any given area is measured by the weight of a column of air having that area as a base and the height equal to that of the atmosphere. This height has not been accurately determined. The density of the air decreases as the distance from the earth increases. For all practical purposes in calculations it may be assumed that this density is uniform throughout. Under ordinary conditions at sea level, the atmospheric pressure is 14.69 pounds per square inch. At this pressure, a cubic foot of dry air at 50 degrees F. has a density or weight of 0.077884 pounds.

Difference in density is due to heat, which expands the air and so reduces the density per unit volume. Were a column of air enclosed in a vertical cylinder, such as a chimney or stack, and heated, the heated lighter air would be forced up by the heavier cold air entering to take its place, which, when in turn heated, would follow the same course. A continuous flow would thus be set up, the velocity and volume of which would depend upon the temperature to which the air was heated, and the height of the cylinder, which would determine the difference in pressure at the base of the cylinder due to the height of the column of air.

The difference in density results from the application of heat, but the action of gravity is directly responsible for the movement of the air.

The relative difference in weight between the air in the cylinder and that of a similar column in the atmosphere may be expressed in any convenient term, as, pounds per square foot, ounces per square inch, or by the height of a column of water or mercury necessary to balance their pressure.

Although usually expressed as "draft pressure," the pressure is below that of the atmosphere, and in reality is a measure of the difference in pressure. This difference in pressure or draft is usually measured in inches of water. One cubic foot of water at 50° F. weighs 62.409 pounds; therefore, a column of water at this temperature 1,728 inches high and one square inch cross-sectional area would exert a pressure of 62.409 pounds per square inch and a pressure of one pound per square inch would be exerted by a column

$$\frac{1728}{62.409} = 27.7 \text{ inches high.}$$

From this, it is readily deduced that an ounce pressure per square inch is produced by a water column 1.73 inches high and that one inch head of water is equivalent to a pressure of 0.578 ounces per square inch. Table No. 8 shows the relation for different heights of water column. Table No. 9 indicates the height of water column corresponding to any given pressure in ounces per square inch.

TABLE NO. 8.

Pressures in Ounces per Square Inch Corresponding to Various Heads of Water in Inches.

Head in Inches.	Decimal Parts of an inch. .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0......		0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46	0.52
1......	0.58	0.63	0.69	0.75	0.81	0.87	0.93	0.98	1.04	1.09
2......	1.16	1.21	1.27	1.33	1.39	1.44	1.50	1.56	1.62	1.67
3......	1.73	1.79	1.85	1.91	1.96	2.02	2.08	2.14	2.19	2.25
4......	2.31	2.37	2.42	2.48	2.54	2.60	2.66	2.72	2.77	2.83
5......	2.89	2.94	3.00	3.06	3.12	3.18	3.24	3.29	3.35	3.41
6......	3.47	3.52	3.58	3.64	3.70	3.75	3.81	3.87	3.92	3.98
7......	4.04	4.10	4.16	4.22	4.28	4.33	4.39	4.45	4.50	4.56
8......	4.62	4.67	4.73	4.79	4.85	4.91	4.97	5.03	5.08	5.14
9......	5.20	5.26	5.31	5.37	5.42	5.48	5.54	5.60	5.66	5.72

TABLE NO. 9.

Height of Water Column in Inches Corresponding to Various Pressures in Ounces per Square Inch.

Pressure in ounces per sq. inch.	Decimal Parts of an Ounce. .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0......		0.17	0.35	0.52	0.69	0.87	1.04	1.21	1.38	1.56
1......	1.73	1.90	2.08	2.25	2.42	2.60	2.77	2.94	3.11	3.29
2......	3.46	3.63	3.81	3.98	4.15	4.33	4.50	4.67	4.84	5.01
3......	5.19	5.36	5.54	5.71	5.88	6.06	6.23	6.40	6.57	6.75
4......	6.92	7.09	7.27	7.44	7.61	7.79	7.96	8.13	8.30	8.48
5......	8.65	8.82	9.00	9.17	9.34	9.52	9.69	9.86	10.03	10.21
6......	10.38	10.55	10.73	10.90	11.07	11.26	11.43	11.60	11.77	11.96
7......	12.11	12.28	12.46	12.63	12.80	12.97	13.15	13.32	13.49	13.67
8......	13.84	14.01	14.19	14.36	14.53	14.71	14.88	15.05	15.22	15.40
9......	15.57	15.74	15.92	16.09	16.26	16.45	16.62	16.79	16.96	17.14

The simplest form of a draft gauge is the U-shaped tube as shown in Fig. 3. To one arm is connected a tube which leads to a point where the draft

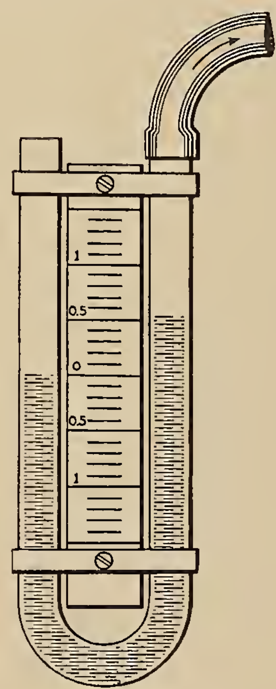

Fig. 3

is to be determined, the other arm is open to the atmosphere. A scale is placed between the arms with the zero mark midway of their height, the scale reading both ways facilitating reading the difference in level. Such a gauge is rigid and compact, but lacks sensitiveness. Gauges multiplying the indications are better adapted for investigation around boilers; such a gauge which is practical and accurate is found in the Ellison draft gauge. In this form of gauge the lower portion of the ordinary U-tube has been replaced by a tube slightly inclined to the horizontal, as shown in Fig. 4. By this arrangement any vertical motion in the left hand upright tube causes a very much

greater travel of the liquid in the inclined tube, thus permitting extremely small variation in the draft pressure to be read with facility.

The gauge is first leveled by means of the small level attached to it, both legs being open to the atmosphere. The liquid is then adjusted (by adding to or taking from it) until its meniscus rests at the zero point on the right. The left hand leg is then connected to the source of draft by means of a piece of rubber tubing. Under these circumstances, a rise of level of one inch in the left hand vertical tube causes the meniscus in the inclined tube to pass from the point 0 to 1.0. The scale is divided into tenths of an inch, and the subdivisions are hundredths of an inch.

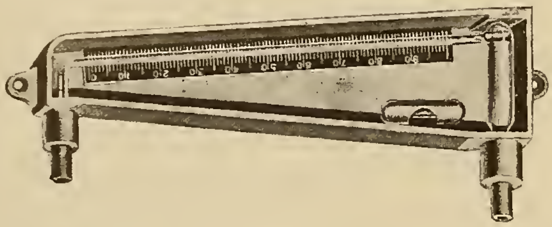

Fig. 4

The right hand leg of the instrument bears two marks. By filling the tube to the lower of these the range of the instrument is increased one-half inch; i. e., it will record draft pressure from 0 to 1½ inches. Similarly, by filling the upper mark, the range is increased to 2 inches. When so used the observed readings in the scale are to be increased by one-half or one inch, as the case may be. The makers recommend the use of a non-drying oil for the liquid, usually a 300° test refined petroleum, but water suffices for all practical purposes.

LONDON GAS AND TELEPHONE CHARGES.

There are seven London companies furnishing gas, and the charges vary from 49 cents per 1000 cubic feet to 69 cents, the illuminating candlepower being from 14/8600 to 16/9200. There is a discount allowed by most of the companies of from 2½ to 5 per cent to large consumers, 10 to 20 per cent for power, and 10 to 25 per cent for gas engines. The charges for gas meters vary, being as follows in four companies: First company, 49 cents for 3 lights to $36 for 500 lights; second, 40 cents for 3 lights to $3.90 for 50 lights; third, 73 cents for 3 lights to $12.16 for 200 lights; fourth, 73 cents for 3 lights to $29.20 for 500 lights. The average charge per 1000 cubic feet for public lamps ranges from 49 to 59 cents.

The rates of subscription (including one telephone at the subscriber's premises) are as follows:

Ordinary message-rate service: (1) Charges for connection with any exchange in the county of London within 2 miles of the subscriber's premises, annual subscription, £5 ($19.46); message fees, 2 cents for each call to a subscriber on any exchange in the county of London, 4 cents for each call to a sbuscriber in any exchange outside the county of London. (2) Charges for connection with any exchange outside the county of London, within 2 miles of the subscriber's premises, annual subscription, £4 $19.46); message fees, 2 cents for each call to a subscriber on the same exchange, 4 cents for each call to a subscriber on any other exchange. The minimum yearly amount payable by each subscriber for message fees is $7.30.

The telephone trunk lines which connect the various telephone exchange areas throughout the Kingdom are under the control of the Postmaster-General and are worked by his officers. The trunk lines can be used by callers at postoffices which are connected with the trunk telephone system, as well as by subscribers and callers using telephone exchanges.

DISCUSSION ON STEAM ENGINEERING PRACTICE.[1]

Depreciation, Maintenance and Up-keep.

J. G. De Remer: Tonight we wish to take up the subject of depreciation, maintenance and up-keep. It is our desire to hear the opinions of the older operating engineers. From these opinions covering many of the plants which have operated and are now operating in San Francisco we should be able to arrive at a fair average charge or percentage to be set aside as a depreciation fund. We shall further get at a definite understanding of what we mean by the term depreciation, and we should also learn something about the general care which the engineers are giving their plants in order to keep down the deterioration which necessitates the depreciation fund. The distinction to be made between depreciation, and obsolescence due to the progress of science and engineering should also be considered by the operating engineer.

H. D. Saville: The calculation of depreciation is an indefinite matter. The California Street Railroad Company plant has been in operation since 1891 for about 19 hours a day. It was built for a speed of 65 r.p.m. and was later increased to 75. The engines have a 54 in. stroke. High, intermediate and low pressure cylinders are widely separated. The high and low may be run as compound or the three together as triple, or the low can do the entire work of all three. It was rebuilt after the fire and is in operation today and is just as economical as it ever was. There are the same boilers with one or two new ones added to the original installation. This is one extreme case.

The Market Street engines which pulled the Market Street cable cars are another good example. There are innumerable cases opposed to this, but the average life where they are not rendered obsolete by virtue of modern improvements is about 25 or 30 years.

The Redondo plant has increased in efficiency considerably over what it was left by the builders, yet plans for a steam turbine installation are now being carried out. A city plant of this company was recently shut down entirely. This plant was not worn out yet modern improvements along the line of turbine development has taken this plant out of continuous service.

G. Lineau: The question of depreciation has various angles. If we are putting in a power plant we want to determine what we are going to put aside for a future fund. The causes of depreciation are two: the economic and those due to wearing out. A boiler might be as good at the end of 20 years as on the day when you bought it. The best way to get this data, is for the members to give general ideas as to the present conditions of boilers, engines, etc..

In the Mills Building Stirling boilers were installed in 1892. Oil was burned for six years. Altogether 13 new tubes have been put in. The boilers are worth as much today as when they were put in, and they are clean and have not depreciated at all and there is no corrosion. There was a little pitting at one time but this was soon done away with. The boilers have not depreciated to any extent. The electric end of the plant however is sadly out of date. The Edison bi-polar generators and Corliss engines being still used. The rest of the plant is as good today as when put in.

[1]California No. 3, N. A. S. E., Aug. 24, 1910.

The insurance inspectors have not reduced the pressure any and it is running today at 125 lb. in contradistinction to 100 lb. a while ago, although there has been no material betterment in the boilers. They are cleaned once a month. Firebrick is a continual expense but this is not concerned with the boiler.

J. B. Williams: I charge 5 per cent as depreciation or reserve fund and my place has been going two years. There has been no expense for repairs or for the boiler end of it, yet I believe that a sinking fund should be provided for any cases of extreme emergency such as accidents, etc. One of these would tear a great hole in the sinking fund. I make a total of 13 per cent in all charges against the plant.

G. Lineau: I contend that the depreciation of the plant is not concerned with accidents. Some plants would not be covered with 5 per cent and an accident should not be charged to depreciation.

J. G. De Remer: Almost all these matters are covered by accident insurance. You pay a premium for this insurance and this would not come out of the fund.

H. D. Saville: Say we have a plant costing $100,000 in round figures, assuming the life to be 20 years, right off there is a depreciation charge of $5000 a year so that we could put in a new plant at the end of 20 years. This might run a year and possibly we could get but $10,000 for it, as is true in the case of automobiles. In my own case in the Merchants' Exchange Building, there are installed two Stirling boilers. In regard to the brick-work it was in bad shape after the fire and was rebuilt, but the boilers never cost five cents except for renewals of accessories and improvements. These boilers are to the mind of the insurance inspectors as good now as any they have ever seen. They are opened once a month and are given the best care. We also have a system of inspection which is well carried out. We have never lost a tube or had one leak. During the winter months the boilers are forced hard though they never leak in any way nor have any accidents. They are in just as good shape now and except for crystallization there is no cause for depreciation being taken into account. There was once a little pitting in a section of the drum but it was immediately noticed and cared for. Since 1904 this plant has been in operation all the time. The other apparatus in the building is constantly receiving care, and 5 per cent is a fair amount of depreciation to be charged against that. The steam pressure has not been changed.

W. P. Milner: Depreciation is what we lose in efficiency, and is the increase in cost necessary to keep a plant in order as it grows older. The discovery of a new system of getting power should not be considered depreciation on a given plant. It might cost $100,000 to secure it and at the time of its being finally put in it might not be modern; so it might not be as up-to-date as a new one or as economical. Take rather the example of a similar plant being put in in the place of the old. Accidents would rather come under the head of maintenance. A man pays out of his own pocket for break-downs, crank getting loose, etc.

W. T. Talbot: There is an insurance against the interruption of service now. Depreciation insures against the gradual wearing out. A plant properly handled might last forever but it would never last forever because of corrosion and the lowering of the pressure sooner or later. A new cylinder must be put in, etc. This is what we are trying to find out.

Chas. Dick: A boiler will not last forever and there is a limit of time for its running and the question is what is that time. A new boiler was put in on the Southern Pacific because the boiler was 27 years old. Would this be a fair depreciation insurance? Two boilers about fifty years old were run at 40 h.p. and these were in good shape with heavy alkali water used. About 15 tubes were put in these boilers in 15 years and if it had not been for the earthquake they would be operating today. The boilers were at one time increased to 100 h.p. After the earthquake the inspector gave 251 lb. more pressure than before. There was nothing in either which was not as good as could be. One boiler could have been sold for $600. It was iron and the plate was one-half inch thick in most places. A steel boiler will get bad much sooner where there is a bad circulation of air. Soot is the main thing with which to contend. Where boilers have a good circulation of air and are free from outside corrosion and well cared for inside I do not know where the percentage could be set.

J. S. Richards: It has generally been the custom on marine boilers to set 5 per cent as the proper depreciation figure, but I have seen some last long enough to bring it as low as 2 per cent, or lower. The Zealandia for instance ran quite a number of years, about 32 years, off and on, and still had her original boilers in her, while others have been renewed in less than half that time. In the sister ship, the Australia, they were tripled but they were not in as good condition. It is hard to study exactly the depreciation on account of the water, the help employed in keeping them, the assistants, etc. The Alameda and Mariposa were re-engined and re-boilered at the same time. One loafed at 13 knots and the other made 15 and a fraction, under the same conditions. The time allowed for cleaning and upkeep was less for the one being driven at 15 knots than for the other. In port you would have from Tuesday morning to Saturday noon to do anything necessary to these boilers so that there were leaks in the back connections caused by rapidly cooling them down while in the other you had eight days in port and no driving or overload and needed no repairs to speak of Once we had to make a trial for the Naval Reserve and developed 4000 h.p. The steam-chart showed that from the time that the word was given to the end of the trial it did not vary 2 lb; it was almost absolutely perfect. She made 15.85 knots.

When the boilers were bad and care was improper, the tubes had to be renewed in two years in the marine boilers. River water was once pumped into the boilers and it corroded them because of the acid in it. As an average I think 5 per cent is not any too much in marine affairs.

In the Monadnock Building the boilers had been misused and had been overloaded and sent from one place to another, but since I have had them I have had to renew only 13 or 14 tubes in them, mostly the bottom row. They are Babcock & Wilcox boilers; I keep after them with tube-cleaners and the scale is now pretty well out of them. I open them up about once in two months. There is a saving all around in the use of Spring Valley water over well water.

As to charging to depreciation the renewal of the plant when it got out of date; if one thing does not do as well as another throw it out and get a new one, is what the American does, and he is here unlike his English brother. I believe that 7 per cent, at least, should be charged against the plant.

F. E. Carmody: The plan the government follows is to set aside 15 per cent for depreciation which includes repairs, putting in new tubes, brick-work, and so forth I have had some of the inspectors say that they have a hard time spending all the money, but they always overdo things a little. I think 5 per cent is not enough as we should charge against depreciation a good deal more than actual repairs to the machinery itself, as for instance repairs that are necessary to keep the plant in good working condition. Depreciation is the value that a thing loses from year to year and this might be called almost anything.. If the life of the boiler is 20 years the depreciation should be sufficient to replace it entirely.

I think that the cost of repairs should not go in on depreciation. One plant that was well operated lasted years and is still running but the cost of repairs was enormous. A plant handled by a careful man should be charged with the repairs.

H. D. Saville: In a plant there is the first cost, then the operation, maintenance, repairs and insurance, and these have nothing to do with depreciation. After a while a cylinder has reached the ultimate depreciation and so with other parts which we must do away with and this only is depreciation.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong

604 Mission Street, San Francisco

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
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Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

A Burning Question

Once again the forest fires are repeating their annual holocaust, and present indications threaten that this year's loss will be greater than that of any preceding, notwithstanding the most strenuous efforts to prevent them. Statisticians tell us that one-tenth of this country's half-billion acres of forested land are burned over every year at an average monetary cost of one dollar an acre and a life cost of one man per thousand acres burned.

A fatal synchronism seems to govern the appearance of these fires at places widely separated geographically. From every Western State during the past month have come reports of forest fires. The attendance at the convention of the Northwestern Electric Light and Power Association last week was limited, because power plant men were trying to protect their transmission lines and generating plants from the onward sweep of this devastating agent, the Seattle municipal plant and that at Snoqualmie Falls having a particularly narrow escape.

In the West forest fires are so nearly a habit, that most people think that it is impossible to prevent them. While this is in a measure true, the history of fire fighting in cities shows that the damage may be greatly minimized by effective organization. A rainless season, uncut underbrush and a careless camper may allow a fire to start, but it is only lack of organization that allows it to spread. The National Forestry Department, together with the several State wardens, have made a good start in the right direction, but are somewhat handicapped in point of numbers. The nucleus for an excellent organization lies among the hydroelectric and railroad employees that are constantly patrolling exposed sections. These men every year are called upon to fight forest fires and it is seldom that due credit is given to their efforts, it even being customary to decry the presence of these corporation representatives in the forests. It is a strange anamoly that the "special interests" are doing more active work in preventing fires than most of the men that are attacking them.

In California, especially, it is the railroads that plough furrows for fire breaks and burn over hazardous strips of ground. They carry the fire fighters to the scene and furnish the means for fighting the fire. All danger from sparks has been eliminated by the new oil burning locomotives. The hydroelectric companies, also, have put trained men into the forest, giving a patrol that quickly reports incipient fires over the companies' telephones. More than once the wide rights-of-way for transmission lines have proved effective fire breaks.

Thinking men realize that the solution of the problem of increasing forest productivity lies in the control of the fires to which they are subject. The nucleus for a forest fire department has been established and it is only necessary that they be given means for quickly reaching exposed spots, and given the numbers necessary to combat what is now proving to be one of the most constant sources of preventable waste.

PERSONALS.

Frank H. Short of Fresno was at San Francisco last week.

Sidney Sprout, electrical engineer, spent the past week in Southern California.

A. C. Sprout left on Wednesday for Siskiyou on electrical engineering business.

F. E. Learned, hydraulic engineer with Allis-Chalmers Company, is making a Pacific Coast tour.

A. M. Hunt, electrical engineer, returned to his San Francisco office on Wednesday after an outing.

John Coffee Hays, general manager of the Mt. Whitney Power Company of Visalia, is at San Francisco.

A. W. Ballard, of the General Electric Company's Los Angeles office, was at San Francisco last week.

John F. Keeran, master electrician at the U. S. Naval Station at Cavite, P. I., is at Berkeley on furlough.

C. L. Cory and C. E. Sloan of San Francisco have been making an engineering investigation at Santa Cruz.

G. R. Field, assistant general manager of the Great Western Power Company, has gone to Big Bend on a business trip.

M. H. Sherman, who is interested in the Los Angeles Pacific Railway Company, was a recent San Francisco visitor.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, left for a trip throughout the East this week.

J. H. Buxbaum, of the firm of Buxbaum & Cooley, electric engineers, Seattle, is at San Francisco and vicinity for a two weeks' vacation trip.

H. W. Crozier, electrical engineer of Sanderson & Porter's San Francisco office, has been spending a vacation in Southern California.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard and Supply Company, has returned to his San Francisco office from Portland.

Delos A. Chappell, who has charge of the engineering work on the Hydroelectric Company's new California development, is at San Francisco.

N. J. Hullin has succeeded G. W. Merrill, resigned, as general superintendent of the Sacramento Electric, Gas & Railway Company of Sacramento, Cal.

J. H. Wise, hydraulic engineer with F. G. Baum & Co., has returned to San Francisco from Alaska after making some important hydro-electric investigations.

Thomas Mirk, of Hunt, Mirk & Co., Pacific Coast agents for the Westinghouse Machine Company, returned to San Francisco on Monday from a trip to San Diego.

H. A. Lardner, manager of J. White & Co.'s San Francisco branch office, is once more at his desk after convalescing from a severe attack of typhoid fever.

H. H. Noble, president of the Northern California Power Company, returned to San Francisco on Wednesday after an inspection trip to the new Coleman hydroelectric development on Battle creek.

H. H. Sinclair, general manager of the Great Western Power Company, has returned from an inspection of the hydroelectric plant at Big Bend. Work is progressing very favorably on the dam.

F. W. Eaton, secretary, F. W. Phelps, auditor, and B. C. Carroll, special agent, formed a party of Pacific Telephone and Telegraph officials who left during the past week on an automobile trip to Lake Tahoe.

George C. Holberton, general manager of the San Francisco Gas and Electric Company, left September 2d for an extensive Eastern trip. He will inspect the lighting and power plants of New York, Chicago and the principal cities of the Atlantic Coast, with a view to gathering information as to the latest improved methods of operation, etc.

P. O. Crawford, the electrical engineer who has charge of installing the Northern California Power Company's new Coleman plant, returned to Shasta County last Sunday, after spending a day at San Francisco. Good headway has been made upon the hydraulic work and the first shipment of turbine water wheels is now en route from the Allis-Chalmers Company's works.

TRADE NOTES.

Charles C. Moore & Co. is installing for the East Side power plant of the Portland Railway, Light & Power Company eight 450 h.p. Babcock & Wilcox boilers, ten Copes feed water regulators, a 12x129 ft. Weber chimney, a Hamilton-Corliss engine, direct connected, and a 2000 kw. G. E. generator.

The Pelton Water Wheel Company reports that a contract has been closed with the Homestake Mining Company, of Lead, S. D., for three Pelton impulse units, of 3000 h.p. each, operating under a high head. Each wheel will be direct connected to a Westinghouse generator. Pelton oil-pressure governors and oil pumping system are provided for. The plant will supply current to a smelter.

The General Electric Company reports that the Phelps-Dodge Company, of New York, has purchased for the Copper Queen Mining and Smelting Company of Globe, Ariz., two A.T.B.4, 750-kw., 1800-r.p.m., 2300-v., horizontal, condensing, Curtis turbines, arranged for operation on the mixed pressure system. These steam turbines are in addition to two similar machines which were installed recently for the same company.

On September 1st, the Central Division of the Pacific Telephone and Telegraph Company was divided into five districts, with a district commercial superintendent in charge of each, reporting direct to John Kearns, the division commercial superintendent at San Francisco. The district commercial superintendents, with their respective headquarters, are now as follows: Chico District, L. M. Brown, Chico; Sacramento District, J. P. Noble, Sacramento; Fresno District, John T. Gross, Fresno; San Francisco District, F. L. McNally, San Francisco; Oakland District, T. F. Delury, Oakland.

NEW CATALOGUES.

Bulletin No. 4764, published by the General Electric Company, illustrates and describes a line of Mazda compensator and low volt lamps.

Archbold-Brady Co., engineers and contractors, of Syracuse, N. Y., have reprinted an article from the Electrical World of May 19, 1910, on "Supports for Transmission Lines," showing some mechanical aspects of flexible tower construction.

Pacific Electric Heating Company have issued an interesting folder describing their popular publicity campaign by means of their "Bill Raiser" series. This is of direct interest to central stations as it should greatly promote the use of current consuming devices.

In a 96-page book entitled "High Efficiency of Centrifugal Pumps" the De Laval Steam Turbine Co., of Trenton, N. J., have brought together some 75 charts, diagrams, photographs and a vast amount of engineering information relating to such subjects as ways and means for testing centrifugal pumps; charts of the results of such tests; the interpretation of these charts for the purposes of the engineers, etc.

PACIFIC COAST ELECTRICAL EXPOSITION.

At a boosting meeting on September 6th the exhibitors perfected final arrangements for the Pacific Coast Electrical Exposition to be held at the new Coliseum in San Francisco, September 17-24. The building will be ready to receive exhibits on and after Monday, September 12th, and it is planned to have everything completed in time for the opening night.

The building has the largest floor space of any public structure west of Chicago and the largest unobstructed area of any building in the world, covering 61,875 sq. ft., every inch of which will be taken in the electrical show which marks its opening.

The lighting arrangements will be spectacular and on a scale never before witnessed in the West. Besides the wealth of electric lights consequent upon the various electric lighting displays, the Coliseum will have an independent illuminating system as beautiful as a fairy scene. Great searchlights, colored globes, artistic designs, waving tinsel decorations and powerful arc lights will combine to produce a riot of light and color calculated to turn the seven nights of the exposition into the most dazzling mid-day brilliance.

The object of the big electrical show is purely educational. Similar expositions have been held in New York, Chicago, Philadelphia and St. Louis. This is the first one over arranged for the Coast or any city west of St. Louis, and all the big national exhibitors present at the others have applied for space in this. It is intended for the more general diffusion of electrical information, by demonstrating the rapid strides made in the use of electricity. It contemplates the display of every device for electrical light, power, transit and transmission. Besides the large mechanical uses of the current, it is aimed to clearly illustrate its advantages in the small household articles being invented almost daily. The electrical cooking machines, flat irons, sewing machines, jig saws, curling irons, toasters, heaters, water heaters, milking machines and hundreds of other useful articles known to many by name only will be intimately introduced to the general public by reason of the exposition.

As illustrating the interest taken by the exhibitors, it is stated that the Southern Pacific Railway exhibit alone will cost upward of ten thousand dollars to install. Many other displays will be equally costly. The National Electric Lamp Association, with branches all over the United States, are also expending $10,000 on their exhibit. They will show electric lamps in the making, constituting an exhibit of great educational value to electricians, to say nothing of its interest to the general public. The Western Electric Equipment Company of New York will provide a display of their wonderful instruments covering almost every field of electrical invention.

Interesting and amusing features will be plentiful. Visitors will be allowed to converse with each other at opposite ends of the Coliseum by means of the wireless telephone. The dictograph, by which messages may be sent by telegraph in the actual handwriting of the sender, will be seen. Other similar mysteries of electricity will be demonstrated and explained. There will be a unique chamber of horrors showing remarkable freaks of electricity. There will be singing and talking lamps and thousands of subjects of interest in the displays.

Every local electrical firm will take part, besides the local electrical contractors, in a body. These latter are devising the midway and other schemes to interest and amuse. The gas and electric companies, the street fire alarm and local police systems, and telephone companies are all contributing displays.

The Bay Cities Home Telephone Company expects to install and operate an exhibit displaying in actual operation the representative types of its telephone equipment. The exhibit will include working automatic switches and the various types of private exchange telephone switchboards now widely used by the company's patrons. Facilities for public telephone service will be provided so that visitors and exhibitors may use the service if they wish. Service is also to be furnished to the exhibitors by means of telephones in the various booths. The telephone company has considered the problem at length in an effort to determine what rates should be named for unlimited automatic telephone service during the period of the exposition and found that the exhibitors are uniformly present patrons of the Bay Cities Home Telephone Company.

As the cost of installing automatic telephone service for each exhibitor will be great enough to prevent a substantial profit at any nominal rate, the company has decided to install an automatic telephone in each exhibit and to furnish the service to exhibitors during the time of installing, showing and removing their exhibits and to make no charge for that service.

National Electric Lamp Association.

The member companies of the National Electric Lamp Association, through their engineering department, are planning an extensive exhibit of the latest developments in incandescent lamps, and will show several interesting devices used in the present day methods of their manufacture and testing.

Among the lamps which wlil be shown will be the complete line of 110 and 220 volt "Mazda" regular, 110 and 220 volt tantalum, tantalum street car lamps, "Mazda" street series, "Mazda" sign lamps and miniatures. Part of the lamps will be shown burning on racks, and the remainder will be exhibited in glass show cases.

Several features are being prepared which will undoubtedly excite considerable interest. There will be shown a device consisting of a box of wood and cloth in which three mirrors and a lamp are to be mounted in such a manner that by revolving the box about a horizontal axis, the intensity of light at any angle in a vertical plane through the lamps may be observed. The apparatus will show how the light distribution about a lamp may be readily obtained, and will illustrate the significance of such distribution.

Another feature will show the balance position of a Bunsen photometer screen for a 100-watt "Mazda" lamp and a 100-watt carbon lamp. Two indicating wattmeters will show the equal consumption of power, while the position of the photometer screen will show the increased light intensity of the "Mazda" lamp over that of the carbon.

A set of automobile headlights, sidelights, etc., will be shown equipped with "Mazda" lamps. Upon an oak rack will be mounted ten 16 c.p. carbon and ten 16 c.p. tantalum street car lamps. An integrating wattmeter will show the kw. hours consumed by each set of lamps during the time of the show.

The booth decorations will be elaborate and in keeping with the general decorative scheme of the Coliseum. A large portion of the booth will be made attractive by means of a pergola, which will be built inside the booth. This portion is intended for the reception of visitors.

Mr. A. J. Hitzker of the engineering department at Cleveland and Mr. L. S. Twomey, the Pacific Coast illuminating engineer for the Association, are already on the scene and are

A pole-top switch for use in the power lines, and adopted by about 80 per cent of the Pacific Coast power systems, for cutting off branch lines and sub-stations and grouping or segregating the main lines, will also be set up so that it can be operated and inspected as though it were in place on the power line.

This company will also exhibit some disconnecting switches for lower voltages of the type that they are furnishing to many large power generating companies, to show the finished excellence of their output.

The Wooll motor protecting switch will also be a part of this exhibit, and the first exhibition of this ingenious and low-priced switch will doubtless be a pleasing discovery for using every effort to make the coming exposition the best of its kind ever held.

Pacific Electric and Manufacturing Company.

The exhibit of the Pacific Electric and Manufacturing Company will interest all those who are familiar with the great development of power transmission in recent years, as it will consist of several switches similar to those used in the mountain power houses and on the miles of high-voltage lines.

An oil switch will be shown, operated with an electric control and made for service under a pressure of 80,000 volts, which will forcefully illustrate the immensity of the machinery that is required to successfully handle the output of the hydroelectric systems.

the many users of small motors who have long been in need of just such protection.

Fort Wayne Electric Works.

The main feature of the exhibit of the Fort Wayne Electric Works is to be their new electric rock drill, which will be publicly demonstrated for the first time at the Pacific Coast Electrical Exposition. A huge block of sandstone weighing seven tons will be the "piece de resistance" in proving the effectiveness of this much-needed addition to mining machinery that may be electrically operated.

H. W. Johns-Manville Company.

The H. W. Johns-Manville Company will feature their latest types of the J-M linolite system of electric lighting, "Noark" service and subway boxes. "Noark" enclosed fuse material, J-M dry batteries, J-M fiber conduit and fittings.

Quite a complete line of J-M asbestos roofing, insulating materials and J-M packings will form an additional feature of the exhibit.

One of the most novel features of the exhibition is to be the display of the various makes of electric vehicles. This convenient and economical mode of urban traction is fast being introduced in Pacific Coast cities. During the show a business meeting of the Pacific Coast Electric Vehicle Association will be held, at which a number of important matters will be discussed.

Descriptions of other interesting exhibits will appear in the next issue of the Journal, contributions being invited from all exhibitors.

Diagram of Floor Space Arrangements at Pacific Coast Electrical Exposition

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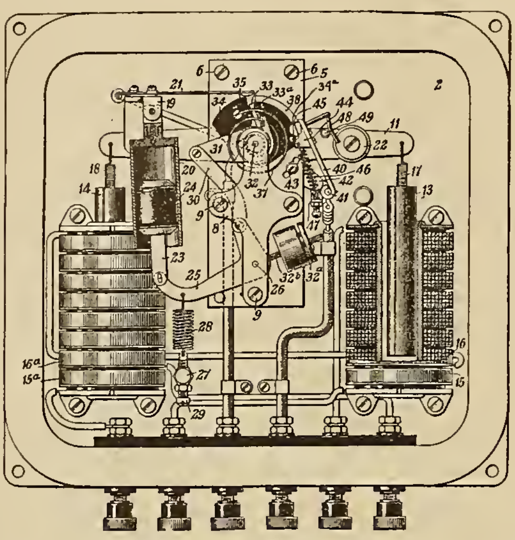
SPECIAL RAILROAD RATES FOR PACIFIC COAST ELECTRICAL EXPOSITION.

For the occasion the Southern Pacific Company has established reduced rates from all points in California to San Francisco on the receipt-certificate, fare and one-third basis for the round trip. The return portions of tickets to be validated by holder at the company's exhibit at the exposition. Tickets will be on sale at all offices at the reduced rate September 12th to 24th, and bear a return limit from the 17th to 27th of September.

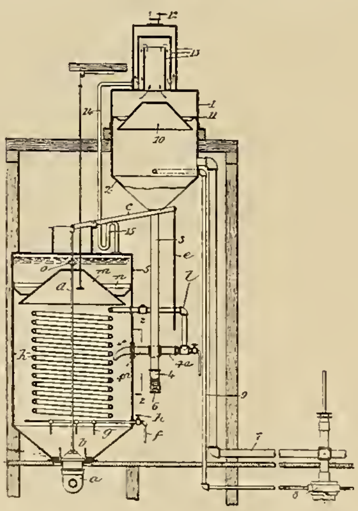
PATENTS

968,579. Automatic Synchronizer. Paul MacGahan, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. The combination with an alternating current circuit, an alternating current generator, and means for



connecting the generator to said circuit, of means for insuring operation of said connecting means when the currents in the generator agree in phase with those in the circuit, said means comprising two solenoids each having two windings, those of one solenoid being arranged to act in opposition and those of the other to act in conjunction when the currents in the windings agree in phase.

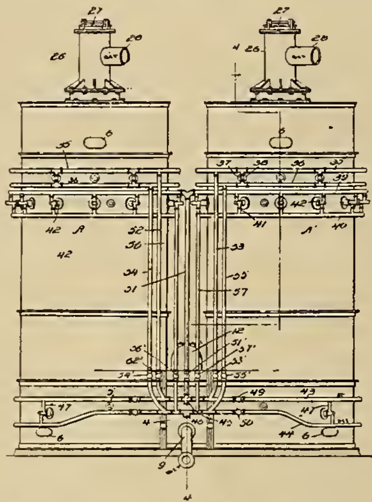
968,534. Gas-Separator for Oil Wells. Linus W. Brown, Bakersfield, Cal. In combination with an oil well, a drum, means for delivering crude oil from the well to the drum, baffle plates arranged within the drum above the point of delivery of the crude oil, a device in communication with the upper portion of the drum, having a circuitous passage for the



outlet of the crude oil gas, a sand and oil separator, and means for discharging the crude oil from the lower portion of the drum into the separator as fast as it is received from the well.

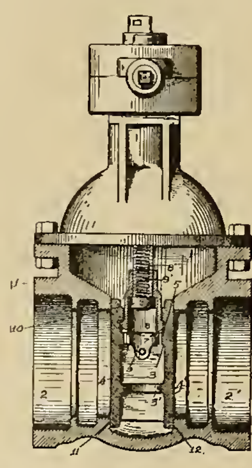
968,640. Refining Petroleum. John C. Black, Richmond, Cal., assignor to Standard Oil Company, Richmond, Cal. The improvement in refining California or analogous petroleum, consisting in forming outside the oil to be treated a mixture of subdivided sulfuric anhydrid and diluent gas, subjecting such petroleum at sludge producing temperature and in the form of burning oil (kerosene) distillate containing smoky or sulfurous hydro-carbons which resist removal by sulfuric acid at 66° B. to such mixture, continuing the treatment with such mixture until an amelioration of the oil is effected in respect to its content of said smoky or sulfurous hydrocarbons, and separating the resulting sludge and the so refined oil from each other, substantially as described.

969,085. Gas-Generating Apparatus. Adelard D. Brasson and Anton A. Yankee, San Francisco, Cal. A gas generating apparatus comprising a pair of generators in communication at their lower ends, each generator having a stack with an air blast pipe connected therewith and provided with a top combined mixing and combustion chamber and a bottom com-



bustion chamber, a set of oil and steam injector nozzles communicating with the lower combustion chamber, a set of oil and steam injector nozzles communicating with the upper combined mixing and combustion chamber, supply pipes connected with said nozzles, distributing pipes connecting the supply pipes of both generators with each other and provided with controlling valves, and a secondary air blast means communicating with the connection between the generators.

968,944. Valve Mechanism for Gate-Valves. George J. Henry Jr., San Francisco, Cal., assignor of one-half to The Pelton Water Wheel Company. In a gate valve for high pressure water systems, the combination with the casing thereof



provided with parallel valve seats, an integral valve composed of two parallel disks separated by a connecting body slidably mounted within the casing and acting against said seats under water pressure, a guide rail within the casing for supporting and on which said valve slides, and means for actuating said valve within the casing.

INDUSTRIAL

SWITCHBOARD EXHIBIT OF AGUTTER-GRISWOLD CO.

The Agutter-Griswold Co. of Seattle recently assembled as a "Made in Washington" exhibit in the window of the Seattle Electric Company some of the work that this company is furnishing to eight or ten large jobs. Included in the exhibit is the large testing switchboard for the Seattle Electric Company's new building, metering panels and cabinets for the new Cobb building, and the equipment for the new Providence Hospital.

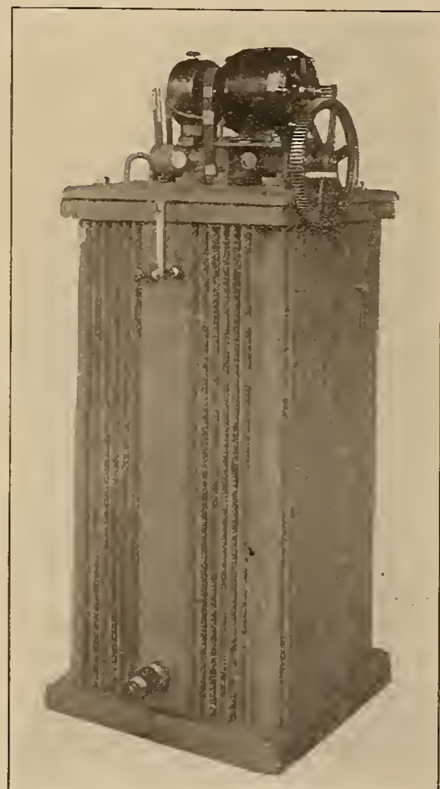
Exhibit Agutter-Griswold Co.

The exhibit as shown in the accompanying illustration includes knife switches, panel switches, metering panels, switchboards, steel cabinets and accessories, all manufactured by this company.

WESTINGHOUSE INDUCTION TYPE POTENTIAL REGULATORS.

The motor operated single-phase induction regulator shown by the accompanying illustration embodies the several improvements recently made in this line by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Although the general design of these regulators remains unchanged, modifications have been made that insure not only a higher degree of satisfactory operation, but longer life.

The skeleton frame construction of the new type single-phase potential regulator permits the use of a "cast-in" corrugated sheet metal tank which affords a larger and more efficient radiating surface than the cast iron tanks used with the earlier regulators, thereby insuring a low operating temperature. This type of tank is also less liable to give trouble from oil leakage, which sometimes occurs with the cast iron tanks on account of unavoidable defects in the castings. In the latter, the leaks usually developed after the punchings and windings had been placed in position, thus causing considerable loss of labor in the work of rectification, while it is noteworthy that, in the case of the "cast-in" tank, a defective tank entails no other loss than the tank itself. In the earlier designs the cast iron tank was bored out to receive the stator punchings. As this tank was open only at the top, difficulty was sometimes experienced in obtaining inner cylindrical surface which would be in perfect alignment with the rotor bearings located in the cover and bottom of the tank.



Induction Type Potential Regulator

Up to and including the 95-kw. size, the polyphase regulators have "cast-in" corrugated sheet metal tanks. They are similar to and possess all the advantages of the "cast-in" type of tank. They possess great strength mechanically, have large radiating surfaces and dirt and dust-proof qualities. An oil gauge at the top and a valve as oil drain at the bottom are provided. The regulator is shipped assembled in its case. Above 95-kw. the regulators are usually oil insulated and water cooled. Boiler iron cases with cast iron bases and covers are usually used.

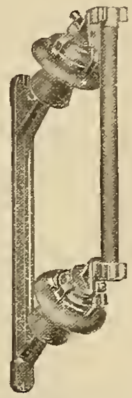
The single-phase regulator has an inherent tendency to vibrate, but this has been overcome in the Westinghouse regulator by a careful design of the bearings and shaft. The moving element is carefully centered so that a uniform air gap is secured. Furthermore, the tendency to vibrate is reduced due to the low point on the saturation curve at which the magnetic circuit of the regulator is worked. An agreeable result of the elimination of the vibration is the noiseless operation of the regulator.

"The Electric Lighting of Automobiles" is well treated in Bulletin 12 from the Engineering Department of the National Electric Lamp Association. It contains valuable and practical data in automobile electric lights and lighting.

HIGH TENSION WEATHERPROOF FUSE AND DISCONNECTING SWITCH.

With the increasing capacity of central station distribution systems it is rapidly becoming recognized as good engineering practice to install disconnecting switches at such points as to isolate the various feeders or important transformer installations. To meet these new conditions a number of weatherproof switches have been developed, but the majority simply furnish a means of disconnecting service without affording protection against overloads or short circuits. Under these conditions it is therefore necessary to also install fuses or circuit breakers at the transformers, or other points of the circuit to be protected.

A solution of the conditions imposed by modern practice is offered in the combined weatherproof fuse and disconnecting switch shown in the accompanying illustration which has been developed into a commercial device after having been thoroughly tested in actual operating service. The line conductors are soldered directly to heavy detachable connectors arranged to be fastened to terminal plates which in turn support a pair of special contact jaws for reception of the fuse chamber.



High Tension Weatherproof Fuse and Disconnecting Switch

The supporting element is made of iron so treated as to resist weather conditions and of sufficient mechanical strength to minimize danger of breakage during installation. At each end of the supporting frame is located a slot to permit insertion of lag screws to attach the device to cross arms, poles or walls.

On two projecting pins are mounted a pair of petticoat high tension insulators having great mechanical strength and high insulating qualities. The design and dimensions of the insulators are such that the standard maximum surface or creepage distance is secured and the factor of safety is then doubled by employing designs for double the actual line voltage or test conditions. For example, a 13,200 volt device is equipped with insulators tested for 25,000 volt line pressure and 70,000 volt break down test.

Fastened at the top of each insulator is a specially designed locking contact device of such contour that the weatherproof fuse chamber can be inserted in the usual manner. The construction is such that a blown fuse can be easily be replaced by the use of insulating tongs, or when desired the entire element can be swung open as a disconnecting switch, thus effectually killing an entire section of line.

The fuse is of the enclosed type and specially constructed to resist weather conditions. The construction is such that the blowing time is practically constant under varying temperature so that transformers or other apparatus can be thoroughly protected by proper size fuses.

Especial care has been taken in designing this fuse to insure rapid condensation of the expanding gases generated by volatization of the metal during the fuse period and to break up their continuity. This rapid cooling and absorbing, or dissipation of these gases is of the highest importance and the result is a fuse which will not only meet the difficult conditions imposed by outdoor service, but also quickly suppresses and prevents holding over of the heavy arc incident to short circuits and overloads.

Rapid lowering of the gas temperature to a point where their conducting power ceases is also of great importance in preventing danger of explosions which would tend to strain or even destroy the fuse casings. In the design illustrated this feature is further safeguarded by employing a casing having high mechanical strength and of such dimensions that internal pressures generated by fusing will not cause damage.

A complete line has been developed for all commercial voltages, the ampere limits at present being as follows:

2200 volts—200 amperes.	13,200 volts—20 amperes.
3300 volts—150 amperes.	22,000 volts— 6 amperes.
6600 volts— 30 amperes.	

The spacing distance between contacts conforms to recognized commercial practice, thus eliminating the danger of leakage under operating conditions, or danger to the line man during installation or inspection. This new device is manufactured by the Delta-Star Electric Company of Chicago, Illinois, and should prove of much service to central station managers operating high tension distribution lines.

NEW CATALOGUES.

The Sprague General Electric type M control system is described in a new bulletin, No. 4761, just issued by the General Electric Company.

Bulletin No. 4754, recently issued by the General Electric Company, describes in considerable detail that company's continuous current and alternating current motors for use in steel mills, and similar places, in connection with cranes, hoists and other apparatus.

In bulletin No. 4746, recently published by the General Electric Company, is described a portable sub-station for the supply of intermittent power for electric roads, and to provide for a temporary supply of power in case of accidents at sub-stations equipped with only one rotary converter unit.

"The Advertising of the Westinghouse Vehicle Motor," as issued by the Westinghouse Electric and Manufacturing Company, contains a number of ads to be used in a popular publicity campaign which will greatly redound to the benefit of central station men in the way of increased demand for current.

The Thomson polyphase watthour meters, which are made for the specific purpose of measuring energy in any two-phase, three-phase or monocyclic circuit, are described in Bulletin No. 4762 of the General Electric Company. These meters may be applied to a circuit carrying a mixed load of lamps, motors or other translating devices, and will record accurately, irrespective of unbalanced load conditions.

The first of a series of booklets entitled "Modern Merchandising Establishments," has been issued by the Nernst Lamp Company in conjunction with companies dealing in high class store furnishings, with a view of giving merchants information of value in store arrangements. The first booklet deals with Marshal Field & Co.'s Chicago store, and the next will be on the new Higbee store in Cleveland, and will give a full description of every detail of spacing and display.

Bulletin No. 4758, published by the General Electric Company, is devoted to Mazda sign lamps and contains a statement of the characteristics of these lamps, wiring diagrams showing the method of changing regular multiple sign wiring to series for Mazda sign lamps, and other wiring methods. It contains tables giving the size of wire for feeders, with different arrangements of lamps. It also contains what will be found interesting data on comparative cost of electric signs, illuminated by carbon and by Mazda lamps.

NEWS NOTES

INCORPORATIONS.

BAKERSFIELD, CAL.—The Wagg Water Company has been incorporated by Jas. Ogden and C. B. Warner of this city, J. I. Wagg, F. V. Gordon and F. D. McGuire of Los Angeles, with a capital stock of $100,000.

LOS ANGELES, CAL.—The Midway Light & Power Company has been incorporated by H. L. Dearing and Herbert Williams of Los Angeles, E. F. Hughes of Sierra Madre, H. J. Gondge of Alhambra and C. L. Chandler of South Pasadena, with a capital stock of $250,000. Plants will be located at Moran and Maricopa, Cal., and the principal place of business will be in Los Angeles.

FINANCIAL.

TURLOCK, CAL.—The bonds carried at the election held and an indebtedness of $25,000 will be involved, $13,000 for a waterworks system and $10,000 for a sewer system.

WALLA WALLA, WASH.—Projections of Pacific Light & Power Company are being inspected by C. Z. Mitchell. $30,-000,000 has been borrowed by the company for developments.

MONROVIA, CAL.—An election will soon be called here to submit to voters a proposition of voting bonds in the sum of $50,000 for the construction of a water system and $120,-000 for constructing a sewer system.

OCEANSIDE, CAL.—On September 14th the city will hold a bond election to vote on the proposition of issuing $20,000 in 5 per cent bonds for improvements on the municipal water system, which includes the replacing of wooden mains with iron pipe.

HUNTINGTON PARK, CAL.—The citizens of this place have voted on the question of a municipal water plant. An election was called in order to ascertain whether or not the majority were in favor of a $60,000 bond issue with which to build and equip a municipal plant. The issue was defeated.

SANTA BARBARA, CAL.—By a vote of 6 to 1 with 1430 votes cast, the city has indorsed a bond issue of $200,000 to pay the cost of driving the last mile of the four-mile tunnel through the Santa Ynez Mountains. When completed the upper Santa Ynez basin becomes available as a water supply. The total cost of the work, including dams, is expected to reach $1,000,000.

LOS ANGELES, CAL.—The Council has authorized the issuance of $6,500,000 harbor improvement and aqueduct power plant bonds recently voted by people of this city. The Council authorized the issuance of $3,000,000 of harbor bonds which when available, will be used in pushing to completion the proposed construction of the harbor highway, and establishment of municipal wharves, docks and warehouses. A second ordinance was adopted authorizing the issuance of $3,500,000 for aqueduct power bonds. The money will be available about October 1st.

TRANSPORTATION.

SALT LAKE CITY, UTAH.—The County Commissioners have granted a 50-year franchise to A. Evans et al., to construct an electric suburban railroad through Utah county.

LOS ANGELES, CAL.—A cross town line has been recommended by the board of public utilities. The route proposed is west on Vernon, from Santa Fe to Vermont avenue, north to the S. P. crossing; north to Jefferson, east on Jefferson to Hoover, north to Park View, north to West Seventh street, west to Rampart and north to West Temple.

TACOMA, WASH.—The council has passed an ordinance permitting the Northern Pacific Railway Company to erect and maintain poles and string wires for the transmission of electric power in Railroad avenue.

SOUTH BEND, ORE.—J. D. Carey has asked the cities of South Bend and Raymond to grant him a franchise to build and operate an electric road between the two cities, and if granted, agrees to begin work immediately.

LOS ANGELES, CAL.—H. E. Huntington will construct an electric line to connect Redondo Beach with San Pedro. Surveyors are mapping out a prospective right of way for an electric line along the cliffs overshadowing Point Vicente and Point Fermin.

PASADENA, CAL.—The officers of the Pasadena Rapid Transit Company have sent notices to the stockholders calling a meeting for October for the purpose of creating a bonded indebtedness of $3,000,000 which is to be used to secure the balance of the right of way between Pasadena and Los Angeles, and to purchase power house and depot sites necessary to complete the proposed electric line. President Horace Dobbins states that construction of line will begin some time during the winter.

VANCOUVER, B. C.—The 65-mile interurban line of the British Columbia Electric Railway Company between Vancouver and New Westminster, is now 11 miles out from Vancouver. Other work under way includes 8 miles from Vancouver to Port Gray, two miles in South Vancouver, two miles between North Vancouver and Capilano, and a completed stretch of 2½ miles between North Vancouver and Lynn Valley. A 6000 kw. auxiliary steam turbine plant has been recently completed and a 2000 kw. rotary converter added to the Vancouver substation.

TRANSMISSION.

PRESCOTT, ARIZ.—The Arizona Power Company is to expend $100,000 in building a new 40-mile wire from Verde valley to Prescott by the way of Jerome.

SPRINGFIELD, ORE.—District Manager Spencer of the H. M. Byllesby Company announces that the company's power plant here, will have a redoubled capacity, work to begin this year.

UPLANDS, CAL.—The Pacific Light & Power Company will construct a power line from Sixteenth street wells line, north and east of the city, directly north to Wineville, a distance of 11 miles. A power station (substation) will be erected in the vicinity of Cucamonga.

BREMERTON, WASH.—The Council has granted to the Bainbridge Development Company authority to construct and maintain poles and wires over the roads and highways of Bainbridge Island, Kitspa county, State of Washington, for the purpose of the transmitting, distribution and sale of electric current for electric power, heat and light.

ILLUMINATION.

PRINCE RUPERT, B. C.—City Engineer Davis is preparing plans for temporary and permanent lighting systems.

LEWISTON, IDAHO.—E. H. Libby of the Lewiston-Clarkson Improvement Company asking the city for a lighting and heating franchise.

HOQUIAM, WASH.—Reports have been received here that the gas syndicate which has brought gas to Olympia and Gate will extend its system on to Aberdeen and this place.

REDMOND, ORE.—An application has been received from the Odin Falls Power Company asking for a franchise to furnish this city with power and light.

REDMOND, ORE.—The Council has passed an ordinance granting a 20-year franchise to the Crook County Water, Power & Light Company to furnish the city of Redmond with electric light and power.

SAN FRANCISCO, CAL.—The San Francisco Gas and Electric Company has plans for a reinforced concrete battery house which is to be erected on Minna street, east of Eighth street. The work will cost about $10,000.

LOS ANGELES, CAL.—An ordinance has been passed consenting to the abandoning of a portion of a street franchise granted to Robert March and John Houze, commencing at Vermont avenue and Thirty-ninth street.

LOS ANGELES, CAL.—The Board of Public Utilities has approved the petition of the Los Angeles Railway Company asking for permission to abandon a franchise granted several years ago for a line along Park View avenue from Ninth to Eleventh streets.

POMONA, CAL.—The City Trustees have instructed the Southern California Edison Company to install incandescent street lights on E. Third, Fourth and Fifth, Kingsley, Palm, Laurel and Williams, W Fourth, W. Holt, North Garey and Illinois streets.

MADRAS, ORE.—There is a prospect of Madras getting a public water system and electric lighting plant. The Newport Engineering Company of Portland is now taking an interest in the matter and its representatives will look after securing a franchise from the city of Madras to install the plant and maintain service.

SAPULPA, OKLAHOMA.—The Sapulpa Electric Company has been purchased by H. M. Byllesby & Company of Chicago, who will hereafter operate and manage the property. The electric lighting and power system at Sapulpa is new, but in the past has been able to serve only about one-half of the immediate demands. Byllesby & Company will at once install a 500 kw. generating unit which will more than double the capacity at the station.

CREEDE, COLO.—MacArthur Brothers Company has been awarded a contract by the Rio Grande Reservoir & Ditch Company for the construction of a storage reservoir at Santa Maria Lake, twenty miles from Creede, Colorado. The work will consist of a large earth dam, about 90 feet high, a 40-inch continuous wood stave pipe, 8000 feet long;, an outlet tunnel, about 600 feet long; an outlet canal 3000 feet long; spillway, diversion dam, and a large amount of ditch work. Amount of contract, $200,000. Work will be started immediately and will be completed by next summer. MacArthur Brothers Company have just completed a large dam for the Eastern Colorado Power Company, near Boulder, Colo., and will be able to shift much of their plant onto this work.

WATERWORKS.

OGDEN CITY, UTAH.—Upon the recommendation of the waterworks committee it has been ordered that a 6-inch water main be placed from Washington avenue to the State Industrial School.

HILLSBOROUGH, CAL.—A contract has been let to M. A. Elftman of San Mateo for the concrete work in a new 500,000-gallon reservoir which is to be constructed in the hills back of Uplands.

SEATTLE, WASH.—The Council has passed a resolution providing for the improvement of a portion of First avenue West and Queen Anne avenue; First avenue North; Florentia street by the construction of watermains.

SOUTH BEND, WASH.—P. E. Hall of Everett has asked the city of South Bend to grant him a franchise for 45 years to furnish a supply of water for manufacturing and fire protection purposes.

LOS ANGELES, CAL.—Engineer F. E. Trask, Los Angeles, is making plans for an extension of the municipal water system of Ontario, to cost $125,000. A new reservoir will be built and pipe lines laid.

BENTON, WASH.—At the meeting of the Benton City Council a discussion relative to the securing of water for domestic purposes was brought up and was finally disposed of when a committee was appointed to confer with the Prosser Power Company and ascertain on what terms water could be produced and furnished from wells.

REDONDO BEACH, CAL.—A syndicate composed of Los Angeles capitalists is negotiating with Hermosa Beach Land & Water Company for the purchase of the water system which supplies Hermosa Beach, Shakespeare and Manhattan Beach with water. In case the deal is consummated, the system will be enlarged and a new pumping plant installed.

ASHLAND, ORE.—If the City Council adopts the recommendation of W. J. Robertson, consulting engineer, the city will install a water system adequate for a city of 50,000 This system includes a high pressure reservoir of 4,000,000 capacity, and a low pressure reservoir holding 1,000,000 gallons, together with a complete re-arrangement of the pipe lines, and can be established by an expenditure of about $100,000.

BURLINGTON, WASH.—The rapid increase of population in the town of Burlington has brought about a condition that makes a water supply for the town an immediate necessity. V. M. Harpst of the Harpst Lumber Company, has long taken a deep interest in this water question. The Commercial Club took the matter up and appointed I. J. Howe, O. Peterson and C. I. Henderson as a committee to confer with Mr. Harpst.

TELEPHONES.

ELMA, WASH.—Telephone connections east of here were destroyed by forest fires.

VICTORIA, B. C.—The B. C. Telephone Company will erect a building for central station in this city.

BUTTE, MONT.—The Montana Independent Telephone Company will install an automatic long-distance system.

RENTON CITY, WASH.—Arrangements are being made for a large number of telephone extensions in this place.

VANCOUVER, B. C.—The B. C. Telephone Company will remove poles from business section and run underground conduits.

VANCOUVER, B. C.—C. P. R. cable between here and Victoria is nearing completion. It will be ready about October 1st.

VANCOUVER, WASH.—The Spokane, Portland and Seattle Railway is equipping lines to handle service by telephones.

MISSOULA, MONT.—Rocky Mountain Bell Telephone Company is making rapid progress on repairing line to Wallace, Idaho.

GRANGEVILLE, IDAHO—Telephone lines between this place, Stites and Elk City are under re-construction. Percy Ellis of Stites is in charge.

TACOMA, WASH.—The commission has ordered all telephone companies to have all overhead telephone wires underground before September, 1911.

PUYALLUP, WASH.—John King & Son of McMinnville have purchased controlling interest in Puyallup Valley Home Telephone Company. They contemplate important extensions in the near future.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 12 — SAN FRANCISCO, SEPTEMBER 17, 1910 — PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXV SAN FRANCISCO, SEPTEMBER 17, 1910. NUMBER 12

THE STORY OF THE DEER CREEK POWER PLANT

BY ARCHIE RICE.

GLIMPSES OF THE DEER CREEK POWER PLANT.
(1) Where Big Tunnel ditch emerges: (2) Canal coming into forebay reservoir: (3) Forebay reservoir; (4) Ditch-tender's home at reservoir (5) Riveting the pipe before putting it underground: (6) Pipe-line trench down the ridge: (7) The power house (pipe-line enters at right): (8) The generator: (9) The transformers: (10) Old sawmill shacks: (11) The foreman's house in winter garb

Waterpower is wherever it is developed. There are natural lofty falls, like those in the Yosemite, but generally man is debarred from using them for commercial purposes. After mining engineers inspected the Cripple Creek District in Colorado and reported that the geological formation was not right for gold, some ordinary, ignorant miners found Cripple Creek one of the richest auriferous deposits in the world! So there are men who will shrug their shoulders and say, "Gold is where you find it."

About fourteen miles northeasterly of Nevada City in Nevada County, up among the Sierra ridges of California, is the Deer Creek power plant. It is hidden away in the obscurity of a mountain region that has few visitors. Close to where it stands used to be an old sawmill. But after the woodsmen took their harvest of big timber from the slopes the district had no particular interest for anybody else. Years went by. And a great opportunity waited to be discovered.

The simplest and cheapest hydraulic development in California lay there dormant till some one should see its possibilities. The Folsom power plant, twenty-two miles up the American River from Sacramento, began its pioneer productiveness in 1895. Even before that Eugene de Sabla had started work for the Nevada power plant, on the South Fork of the Yuba River, about six miles over a ridge and down a gorge to the northwestward of Nevada City, with a three-mile ditch system from a river dam upstream. While the builders struggled with their first dam and lost it in the flood waters and lost the chance of having the first power plant for long-distance transmission of electric energy, there was this Deer Creek possibility off in the other direction, with not half the work and with nearly five times the possible power. Only the engineers didn't happen to see it. Few people went over that way. But the Yuba River was a big suggestion of of waterpower to any one.

In the days of miners' ditches, when hydraulic giants were turned to flush California hillsides away in a wholesale search for placer gold, there were many systems of mountain water developments. Off to the northeastward of Nevada City and Grass Valley are mountain lakes. They were tapped with ditches, meandering down to form the great South Yuba water system of canals and flumes for mines and for domestic and irrigating purposes. Out of Lake Spaulding a great ditch extended westerly toward Nevada City and pierced through a hill about a mile. Then part of its flow was carried on, and part was diverted into Deer Creek as a convenient channel to take it down toward Grass Valley. That saved making a canal, and downstream a diverting channel conveyed it on again whither man desired it to go.

The old ditch men knew in a general way that the grade of that creek was rather steep. Some of them would "reckon" it must be a fall of two or three hundred feet, may be! And they let it go at that. The creek route was a convenience. The storage water from the chain of lakes was turned into that creek channel and then taken out again just where man wished to divert it.

Along in the year 1905 Frank G. Baum, at that time electrical superintendent for the California Gas and Electric Corporation, happened to be out prowling round looking over the company's water sources. He had studied the topographical maps, and he got to thinking that there must be quite a fall in that Deer Creek route. So he took an aneroid barometer and studied the altitude up at the tunnel mouth and where the waters were turned into the creek. Then he clambered along down the creek to where the water was taken out again. It seemed to him like something more than a nine-hundred-foot fall. He figured that all that was necessary was to make another canal from near the mouth of the tunnel and lead that flow gradually round to the top of a convenient ridge and then shoot the water down through a pipe to a power house to be erected on the bank of the creek.

It was a simple problem, considering the difficulties of most mountain hydraulic development work. No head dams were needed. No great physical obstacles were to be overcome. There was an abundance of water back in the lakes. Only a canal had to be made to the proper point. There a forebay reservoir could be scooped out and banked up. Then a pipe-line trench could be dug through the forest and down the steep ridge to the creek. The old sawmill road was still available, right in to where the power plant would be located. Easy? Why, it was like finding a gold mine with a ledge sticking out of the ground.

So the work of development was started by the Pacific Gas & Electric Company in the summer of 1906. Contracts were let: to the Schaw-Batcher Company of Sacramento for the pipe-line, to the Pelton Water Wheel Company for the impulse wheels, to the Westinghouse Company for the generator, and to the Stanley Company for the transformers. Then came a financial slump. Work was stopped. Nothing was done till the approach of the winter of 1907. When money became easily available things went with a rush. New demands had come upon the growing company for additional electric power. Deer Creek was needed in the system. Mud or no mud the heavy machinery had to go in right then over those mountain roads. In places near the proposed power plant the mud was so deep that the front wheels of the great wagons would sink to the axle and not revolve. The wheel horses had to be unhitched, and the wagons actually dragged along sled-fashion over the ooze. An old teamster who had boasted of muddy roads he had known remarked, "Over there in Nevada it got so bad sometimes I could only see the mules' ears sticking up, but on this dern job I only look for bubbles!"

The mud was so soft and deep that small pine trees were felled by the thousand, and their trunks laid side by side to form a corduroy road. More than five miles of that corrugated log surface was spread for the passage of the heavily loaded wagons.

A good deal of that old rumpled surface still remains. Unless you have ridden over a corduroy road you can have no conception of what the sensation is like. The horses must walk. At first, for a few yards, the motion is roughly suggestive of the nervous action of an old lady in a rocking-chair. Nor do you mind it. But as yards grow into rods and rods into miles and miles multiply, the jerking back and forth suggests an effort to bend your spine as you bend a piece of metal to the breaking point. It keeps you busy bowing. You become a blithering idiot, nodding approval to every log. After two hours of it you clinch your teeth to hold them in the gums. Your conscience has become so calloused that you actually approve of the driver's continued cursing of corduroy roads. The horses go thump, thump, thumping along over the slender logs, and the buggy whip jerks back and forth thousands of times. It gets tiresome. You fear to open your mouth lest your teeth shower out like so many white beans.

When you reach the power plant your host will say, "Why, I reckun you ought tuo come in by thuh lowuh road!"

You return by the lower road, luxuriating in its comparative smoothness, in its shade and in the majestic forest giants and the vari-colored splendors of wild blossoms and decorative foliage.

When you get back to Nevada City, late at night, not even a mining engineer in the hotel office, wearing a new suit of corduroy, can make you resentful

or at all forgetful that you are as hungry as a long day and mountain air can make a man.

The Deer Creek power house is a solid-looking little cement building, right in the acute angle of a Y described by the union of the two branches of Deer Creek that form the main stream. Back of the building the pine-grown slopes of the Sierras start up with a suddenness that suggests toboggan slides. Only you happen to be there, of course, when the sun is beating down into the vortex and the hillsides reflecting their heat through a shimmering surface atmosphere.

Then the tall, genial, young southerner who manages the station says: "See all that hillside they-uh by those old shacks? Well, suh, that they-uh is sawdust. It's ten feet deep with sawdust. Used to be an old sawmill right they-uh, suh. Man named Coopuh owned it. He was the farth-uh of H. M. Coopuh, thuh company's managuh ovuh at Aubun. Snows good deal up heuh in wintuh. This heah-uh's thuh highest lectric plant in thuh company's whole system. Altitude of pow house is three thousan seven hundred feet. Las wintuh thuh boys dug uh hole in that they-uh sawdust an filled it plum full uv snow an covud it up. Why, we've had snow, reguluh ice, fuh five months fuh ice-cream."

You beam and collect a cottony dryness in your mouth. Then he dashes your hopes.

"Only just used thuh last uv it yestuday, suh. And now if yuh ready we'll walk up tuh thuh resvoir. It's only uh mile by thuh pipe-line, if you do n't mind uh lil walk up hill."

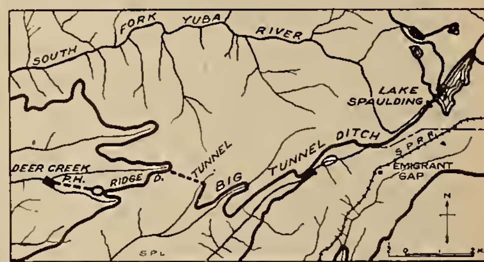
You look all around to see if you can't spot the driver who claimed he knew all the roads, and induce him to come along—that corduroy kink still in your spine. But he's hidden safely away somewhere in a shady spot. So you tackle the slope, trailing along behind the man that is used to the altitude. You puff and perspire, and regret you didn't bring the driver.

Having raised yourself nearly a thousand feet and your temperature in proportion, you come out of the forest into a beautiful clearing rimmed with stately pines standing sentinel around a lovely little lake. Swim? Why, you could die in that lake! And then the superintendent bows a gallant southern courtesy, and you turn and see the ditch-tender's wife as she emerges upon the porch and nods pleasantly across lines of snowy washing. Swim? Well, may be up the canal, above the lake somewhere.

"You see this watuh goes down tuh thuh pow house an then they drink it down in Grass Valley, so weuh mighty careful bout keeping it clean and nice."

Swim? You compromise by scooping up a palmful and wetting your throbbing temples.

Hauling the Deer Creek Pipe in over the Snow.



Location of Deer Creek Power House and Its Water Sources.

Putting in the Curve of the Deer Creek Pipe Line in Midwinter.

Now they did a great thing when they stopped turning the water into the creek channel. It used to go tumbling down a rocky, porous ravine. But nobody estimated the loss. When they made the new ditch and the reservoir they found they had in the diverting canal going to Grass Valley thirty per cent more water than used to reach it. Seepage and evaporation had been stealing nearly a third of the volume by the creek route.

Four men in the company were particularly identified with the construction of the Deer Creek power plant. Frank G. Baum started the idea. James H. Wise had charge of the civil engineering problems. C. F. Adams supervised the electrical construction work. And A. L. Wilcox carried through the details of the power-line from the plant over the ridges eastward to the Alta power house.

The Deer Creek plant was established to conform to a standard. Other and earlier plants had been constructed after the ideas of their various founders.

When the great company bought and absorbed them it found it had many kinds and sizes of apparatus. At Deer Creek the big, single, generating unit was patterned after the units of the Colgate plant, so that in an emergency, with several plants having like parts, there could be sections readily available for transfer where most needed. The necessity came while the Deer Creek plant was being constructed. A bearing went to pieces over at the big plant at Electra. The Deer Creek bearing, being of the same standard size, was rushed over there, and thus a delay of several months was avoided in waiting for a new part to come out from the east.

Earlier penstock construction brought pipe-lines directly down to the back of power houses. There was an element of danger in such a scheme. A break in one of those mighty pipes might send torrents of water battering away at the building, undermining its foundations, wrecking valuable machinery in a few moments. So at Deer Creek the engineers brought the pipe-line down at a long tangent, and then gave it a curve to the westward near its lower end, where it finally forked Y-shape to produce two streams to play into the double set of water wheels, one attached to the projecting shaft on each side of the generator. If the long pipe-line coming down the hill at Deer Creek should ever break, the downrush of water will shoot off free and not menace the power house and its site.

Newest of all the eleven hydroelectric power houses in the company's great system of eleven mountain generating plants, the Deer Creek station is small, compact, simple, and fifth in kilowatt capacity. It has one big generator turning at three hundred revolutions a minute and producing 5500 kilowatts; and three water-cooled and oil-insulated 2000-kilowatt transformers. The transformers step up from 2300 volts to 60,000 volts, the voltage at which the power is transmitted way down to Sacramento. There the line unites with the main system. Another line goes over the ridges easterly to the Alta power house. There, through a bank of transformers, the Deer Creek power is again paralleled with the main system by connection with a 23,000-volt line from the Colgate power house.

In one corner of the Deer Creek power house is a small machine shop where most of the ordinary repair work can be done. The auxiliary apparatus of the station consists of a sixty-kilowatt, sixty-volt exciter, direct-connected to an impulse-type water wheel and an eighty-five horsepower induction motor. And there is a type Q Lombard governor, with oil pressure pump and tanks.

If you ever acquire a yearning to get away from the insistent demands of society, tire of theater-parties and dinners and balls and crowds and all that sort of thing, go to Deer Creek. You will not meet even a brush rabbit on the road, going or coming. And when you get there you can spread your hammock under the pines and look up at the sizzling slopes and call faintly for more iced-cream. That is, unless you go there in winter. Then you will sit close up to the stove and sew a pair of socks on your old straw hat for ear-flaps before you venture out into the soft depths of "beautiful snow." But you will not be asking for iced-cream.

PHYSICAL DATA DEER CREEK POWER HOUSE.

Capacity of storage reservoirs	1,975,568,000 cu. ft.
Area of storage reservoirs	2, 160 acres
Miles of ditch and flume	19.5
Flow the second in ditch	100 cu. ft.
Pressure head (height of fall)	837 ft.
Force of water the square inch	360 lbs.
Number of impulse wheels	2
Capacity of generator in kilowatts	5,500
Total electrical horsepower	7,400
Generating voltage	2,300
Voltage on power-lines	60,000
Altitude at power house	3,659 ft.
Altitude at forebay reservoir	4,496 ft.
Size of power house	41 x 53 ft.
Material of building	Concrete walls, galvanized iron roof, steel frame.
Plant placed in service	May, 6, 1908

NEW ELECTRIC-TURBINE LOCOMOTIVE.

A new type of locomotive known as the "turbo-electric" has been constructed at Glasgow, and recently tested on the Caledonian and North British railways. Trials, which are not yet completed, are said to have been satisfactory so far as they have progressed. This new type of locomotive is a self-contained steam-electric generating set. Steam is generated in a boiler of the ordinary locomotive type, which is fitted with a super-heater, and the coal and water supplies are carried in the side bunkers and side water tanks at both sides of the boiler. The steam from the boiler is led to a turbine of the impulse type running at a speed of 3000 revolutions per minute, to which is directly coupled continuous-current variable-voltage dynamo. The dynamo supplies current and pressures varying from 200 to 600 volts to four service-wound traction motors, the armatures of which are built on the four main or driving axles of the locomotive. The exhaust steam from the turbine passes into an ejector condenser, and is, together with the circulating condensing water, delivered eventually to the hot well.

As the steam turbine requires no internal lubrication, the water of condensation is free from oil, and consequently is returned from the hot well direct to the boiler by a feed pump. The water evaporated by the boiler is therefore returned to the boiler again and again, and the supply of water carried in the tank is actually circulating water for condensation purposes. The condensing water is circulated within practically a closed cycle by small centrifugal pumps driven by auxiliary steam turbines placed alongside the main turbine and dynamo. The cycle of the condensing water is from the tanks through the first pump, then through the condenser, where it becomes heated in condensing the exhaust steam, then to the hot well. From the hot well it passes through the second pump to the cooler, situated in front of the locomotive, where the full benefit of the blast of air caused by the movement of the locomotive, aided by a fan, is utilized for cooling the hot circulating water. After passing through the cooler the water is returned to the supply tanks ready for further condensation.

The condensation of the exhaust steam deprives the locomotive boiler of the usual exhaust blast which induces the draft through the fire box and boiler tubes. In the experimental locomotive the induced draft is replaced by forced draft provided by a small turbine-driven fan. The fan is placed within the cooler so that it will deliver hot air to the boiler fire and at the same time assist the current of air through the cooler.

ELECTRIC TRANSMISSION TROUBLES.

BY C. F. ADAMS.[1]

Industrial application of electricity marks the most notable advance of all history. Twenty centuries ago the message "Peace on earth, good-will toward man" started a moral impulse that is still a compelling force. No individual, society, or invention has quickened the mind, advanced the general welfare, and hastened the coming of "peace and good-will" as has the application of electricity to the uses of every day.

The transmission of speech and signals has blotted out space and time. The transmission of energy has lightened the labors and multiplied the constructive capacity and comforts of the individual. A brief half-century will almost cover the entire progress of the "electric age." A quarter-century will almost cover the electric transmission of energy and the commercial use of the electric light. Read the literature of twenty-five years ago and see how little the founders of the art appreciated its possibilities. Then industries were located along streams capable of power development. The mill and the village represented the manufacturing interest.

But electric power transmission has carried the energy of the waterfall to the city. The single power-station has replaced a thousand small engines. Now power can be delivered at any point where an electric motor can be located. The enormous growth of the city is the direct result. The next few years will see the application of modern power to the farm, and a restoration of interest in agriculture.

The purpose of this article is not to forecast the future, but to inquire as to some of the causes that tend to limit electric service. What are our ordinary "electric troubles"? and why do they exist?

In the transmission of electricity we have advanced from the small central station, with its maximum range of a few miles, to systems, operating under single control, serving a territory larger than a commonwealth. In transmitting voltages we have progressed by stages from 1000 volts to 130,000 volts, and the final limit is reached only when losses through the air from line to line render operating costs prohibitive. The advances in the art of transmitting electric energy have been accomplished by careful study of "the weak point," and by the selection of the best method and material as determined by service trial.

The entire problem of transmission is to confine electric current to a selected channel; to keep it from escaping from the wire.

The sole tendency of an electric current is to return to the point at which it was generated. Insulation of numberless forms has been developed to confine this force to useful paths. Practically all the "troubles" of the art are those due to some defect in insulation.

In the work of power-transmission the troubles confronting the engineer may be examined in their normal order as those relating to generating apparatus, to motors, to transformers, and to transmission lines.

[1] Engineer of Electric Construction, Pacific Gas and Electric Company.

Generator Troubles.

The modern dynamo well exemplifies the law of the survival of the fittest. It is the result of evolution and selection. From small and crude designs generators have evolved into a form of machine which is practically standard. The high velocity of steam has been utilized to great advantage in the simple high-speed turbine, with its special design of dynamo. In hydroelectric plants practically no new designs of dynamo have appeared in the past five years. The high efficiency strong construction, and durable insulation of the modern dynamo make it one of the most dependable of machines.

There is so small a limit of possible improvement in the efficiency of the modern dynamo that further progress in its construction is questionable. The "troubles" are generally due to heat, to vibration, and to moisture. The insulation enclosing an armature coil consists mainly of a vegetable fabric, impregnated with an insulating varnish or compound. The useful life of an insulation material is limited to its flexibility. High temperature reduces its physical strength, and renders it brittle. Long-continued heat lessens its dielectric strength, and gradually reduces it to carbon.

An electric conductor imbedded in an armature slot is subject to heavy mechanical strains. A current-carrying conductor (be it copper bar or wire) is alternately repelled and attracted by the powerful magnetic field which, swiftly revolving in front of it, produces electric energy in the copper. Unless this conductor is firmly secured in its slot there will be vibration which, in time, will pulverize the insulation about the copper and result in current-leakage and damage. This pulverizing of the insulating material is greatly hastened where the edges of the grooves are not true and smooth on the side walls and the bottom of the armature slot.

Where an armature coil consists of a number of flat copper bars wound into several turns the individual bars tend to repel each other. The vibration resulting from this repelling force destroys the insulation between the turns, and the copper itself is crystalized and fractured. Another form of "trouble" experienced in the multiple-turn coil is the unequal expansion of the conductor; the centre turns of the copper, having less radiation, will expand most, and will crowd the other coil turns to a dangerous degree.

For these and for other reasons the most stable form of electric generator is the one having the fewest armature turns. Two conductors to the slot is the preferred type, and these conductors should be of cable or strand if the armature is of the open-slot type. Where the armature insulation becomes worn and the copper conductor comes in contact with the iron, the damage done depends on the extent to which the machine is "short-circuited."

In a generator or motor every foot of armature conductor affected by the magnetism of the field adds to the total electromotive force of the machine. A single multiple-turn coil may have an induced voltage of from 50 to 500 volts, according to the number of the coil turns, the length of the "active" conductor, the strength of the magnetic field, and the speed of the machine.

Where the short circuit occurs in a single coil the voltage affected may be so low that an arc will not be formed. Under such conditions the short-circuited turns will heat rapidly, char the insulation, and result in damage to the individual coil, and possibly involve other coils if not promptly detected and replaced.

When a short circuit affects voltages higher than 20 volts an arc generally occurs, fusing the copper and sometimes melting out the armature-iron itself.

It was once the privilege of the writer to inspect and rebuild a 500-kilowatt, engine-type alternator that was allowed to run on a short-circuited bus bar for a whole hour under full steam. Not a foot of wire was left in the armature. Every coil melted, warped out of shape, and was torn out of the machine by the revolving element. This giant "pin-wheel" was a gorgeous spectacle while it lasted. Steam was finally shut off. But the drunken engineer who had abandoned the plant never reported for further duty.

During that period of negligence the armature-iron was not burned or appreciably damaged. The single field bobbin (Stanley-type) was warped and sprung by the heat of the blazing armature. The machine was repaired, and after about thirty days was again in use and as good as ever.

Armature troubles are somewhat affected by the type of winding; the manner of connecting coils, whether "delta" or "star"; and also by the potentials existing between adjacent coils. The operator should know his apparatus in every detail; know the voltage a coil and a coil turn; know the high potential points; be able to trace out each phase group of coils. Such knowledge will tend to guard against trouble and prevent failures.

Another class of dynamo troubles are those due to the failure of the insulation of the field coils. The intensity of the electric current is not great, ranging only from 60 to 120 volts; so the liability to puncture is slight. But, because of the weight and speed of the field coils themselves, heavy mechanical strains are imposed on the insulation and cause it to fail. Consider a possible case. In an eighteen-pole machine, suppose a short circuit occurs that will affect six coils. A part of the current will be diverted from these coils, and they will thus be weakened as magnets. Each magnet or pole may have exerted a mechanical stress of 1000 pounds or the armature iron. If the six magnets are weakened only ten per cent this would reduce their mechanical pull of 600 pounds, and the rotor would be out of mechanical balance to that amount. At a speed of 400 revolutions a minute this would possibly wreck the machine before it could be shut down. An accident of this nature is positively the most dangerous thing that can happen to the revolving field-coil-type of generators.

In the Stanley, inductor-type generator this danger is eliminated, as all the magnetic poles are equally affected by any change in the field winding. Field circuits should be as carefully watched and tested as the armature windings. In synchronous motors or in generators that may "fall out of step" there is a possibility in the field windings of an induced voltage many times the normal operating voltage, even rising to 3000 or 4000 volts in large machines. Later failure of insulation may result from such troubles.

Another annoying class of troubles is due to improperly clamped armature laminations. Two similarly charged free poles tend to repel each other. As the sheet-steel armature metal is magnetized by the field magnets it has a tendency to expand. This is due to the repulsion. Any loose laminations are put into violent vibration. Crystalization results. The armature pole, or "tooth" is broken off and drawn into the field. Damage of this nature is chargeable to poor design and inferior workmanship.

There is one destructive agent in all power houses and electric stations that is the cause of endless trouble and of rapid deterioration—dirt. It chokes up the ventilating ducts in the armature-iron, spreads a heat-insulating film over the machine windings, collects free oil or moisture, and gradually rots out the insulation of the machine. Trouble from dirt is most aggravated where constant duty is imposed and where the surrounding atmosphere is dust-laden.

Motor Troubles.

For commercial power work the motor generally employed is the induction motor. The design of this type of motor is so simple that the troubles experienced are generally due to mechanical causes and overload. The running clearance of the induction motor is small, and the wear on bearings or shaft must be compensated for by adjustment. The air gap is sometimes completely closed by dust, as in cement mills, and the removal of the rotor then becomes a difficult matter.

The direct-current motor is largely confined to car and elevator use. On nearly all standard apparatus of this class, the operating troubles have been practically eliminated by careful factory design and construction. Sparkless commutation, carbon brushes, and moderate operating temperatures have corrected most of the former troubles. The use of kerosene oil as a commutator cleanser is recommended in place of vaseline or some other heavy lubricant. A proper carbon requires no lubrication, and the less "dope" used on a commutator the better the results.

Transformer Troubles.

Transformers are a class of apparatus in which the service of an attendant is generally limited to maintaining a constant supply of cooling water and an occasional inspection of the oil to detect the presence of water in the oil. The major part of the power house and substation power transformers are of the water-cooled type. These cooling coils, of iron, brass, or copper, are much affected by the presence of mineral or sediment, carried by the cooling water. The precipitation of such matter is dependent on the water temperature and on the rapidity of circulation. With slow circulation and hot discharge water, the coils will close up from sediment in a short time when the water is bad. Where the cost of water is not an item, its free use is desirable. Where water is limited and expensive the best results are obtained by using a cooling tank of some form and a circulating pump.

Concerning transformer oils and the details of transformer construction much can be left unsaid. The construction details are largely dependent on the caprice of the factory economist. The only argument that impresses and retards this destructive individ-

ual is the cost of replacement of apparatus that fails in service. "Let the buyer beware" is a motto especially applicable to the purchaser of electrical apparatus.

Ten years' operating experience has demonstrated that a thin, fluid oil containing almost no vaseline is best adapted for use in large transformers. The oil serves as an insulator and also as a cooling medium. The heavy oils tend to solidify after long use, and thus close up the circulating channels past the coils. Manufacturers have learned that lower operating temperatures can be maintained with the thin oils, and are now recommending this grade of oil for all power transformers.

The earlier transformer builders relied on very extensive solid insulation over the coils. Unable to dissipate their heat these coils shortly burned up. The manufacturers charged the trouble to the type of oil and raised a cry about low "flashing point," fire risk, etc. The grade of oil was changed to a thicker oil of high flash-test, with no improvement in the life of the transformer.

After some years the idea finally penetrated that the oil itself should come in direct contact with the windings in order best to cool and insulate the coils. Now the subjects of "flash point," etc., are no longer discussed and the old grade of oil, condemned some years ago, is now recommended and used everywhere. Time has thus vindicated the consistent policy of the Pacific Gas & Electric Company in regard to transformer oils.

The presence of moisture in oils, methods of removing the moisture, and the maintenance of the highest dielectric strength are all important. The use of insulating materials, capable of absorbing moisture, has been a step backward. The use of this class of material has been defended by the manufacturer on the ground of lower cost; that a first-class article could not be sold in competition with cheaper goods, and so on. High profit can always purchase an able defense. The demands of the public for first-class, uninterrupted service will be the final argument and will result in higher-grade apparatus.

Line Troubles.

When the total length of the entire transmission line is considered, the percentage of trouble due to line faults is surprisingly low. Consider the length of line exposed and the total number of insulators subject to breakage as well as mechanical failure. There are nearly 1800 miles of line and probably 220,000 insulators in the Pacific Gas and Electric Co.'s system.

Many readers are familiar with the story of the 60,000-volt insulator. The famous two-part "waterspout" type was one of the first designs. This was found to be safe in the foothills, but a failure in the valleys, particularly in the fog districts. Many of this type are still in service in the foothill districts of Butte County.

Type of poles and insulators sustaining long span near the De Sabla power house.

Failure came from puncture through the top of the insulator, and also by creepage over the outer surface. The lower glass petticoat was changed to porcelain, and a second petticoat was added. Later the original cap was changed in form for one of larger diameter, fourteen and sixteen inches being the final dimensions. A third petticoat was finally added, and the standard, four-part, California-type insulator thus evolved is considered the best vertical type insulator made.

It is interesting to note that an eastern power company recently changed all its triple-petticoat top insulators to the four-part type and thereby avoided practically all failures from lightning puncture.

Many of the failures of insulators are due solely to dust accumulations, the insulator being otherwise perfect. Better to illustrate this point, the original eleven-inch 60,000-volt insulator can not be depended on for consant service on 11,000-volt lines in the fog districts. A slight leakage, infinitely small, will in time crease and carbonize a wooden pin or cross-arm, and fire will result. Wooden pins are now practically obsolete, and wooden cross-arms are marked for early abandonment.

The only remedy for dust troubles is to have parallel lines, and at intervals to cut out one line and clean off the dust from insulator surfaces. Hope is entertained that the suspension-type insulator will be trouble-proof in this respect. At least two years' service in the fog districts will be required to demonstrate the ultimate value of the suspension insulator.

The long spans used on the tower lines reduce the number of insulators. The higher lines used in tower construction and their wider separation promise

Suspension Type of Insulator.

some immunity from certain mechanical interferences to which pole-lines are subject. Some form of tower-supported line is being adopted by all the later systems, the item of pole wear and depreciation being a strong factor in this choice.

The log book of any division manager will supply a formidable list of line trouble-makers. Early lines were given a spread of about forty inches in order to reduce line induction to a low value.

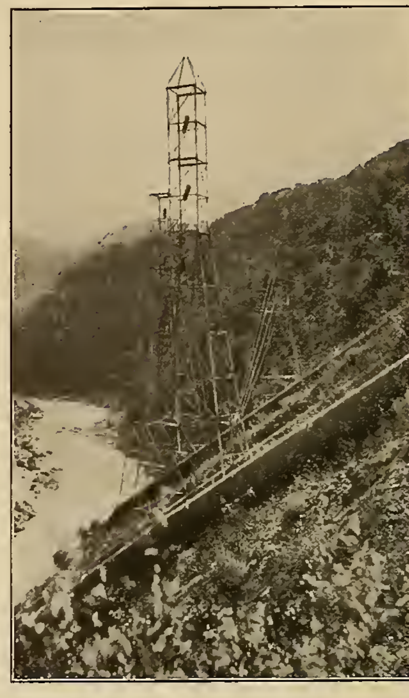
Insulators of the water-spout, the sixteen-inch, and the four-part California-type.

Owls, hawks, eagles, blue cranes, geese, swans, and pelicans all tested these lines to their sorrow and ours. Turkeys, ground squirrels, and house cats tried to perch on insulators and had a brilliant finish. All of the possible accidents have occurred, and the impossible accident has not yet been determined.

Lines of a later date were given a spacing of sixty, seventy-two, and eighty-four inches, dependent on the length of the span. On these wide-spaced lines the bird troubles are very few.

In the higher hills, snow is a factor, and heavier lines and stronger supports are needed.

The line material has been much debated. All commercial types of wire and cable are in use. Copper, aluminum, and steel are used, both the solid and the stranded conductor being employed. The low melting point of aluminum is the chief weakness of this metal, as an arc will cut off an alumium line long before



Initial towers, where power-line starts from power house at Big Bend on Feather River.

a copper line would fail under similar trouble. Line construction materials and methods have followed the laws of evolution. Each year sees some new advance toward greater strength and safety.

The problem of electric transmission from the mountain streams is very largely a problem of line construction and maintenance.

The future power houses on the Pacific Coast will be either steam or hydraulic, dependent on the complete solution of the practical problems in the high-tension line.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION.

The eighth annual convention of the Colorado Electric Light, Power and Railway Association, will be held at the Hotel Colorado, Glenwood Springs, September 21-23. Following is a list of papers which will be read at the meetings: "Storage Batteries in Street Railway and Central Station Work," by T. A. Warfield, general manager of the Colorado Railway, Light and Power Company, Trinidad. "Some Observations on Cultivating Friendly Relations with the Public," by J. M. Connelly of the Denver Gas and Electric Company, Denver. "Mazda" Street Series Lighting," by R. L. Jones, General Electric Company, Denver. "High and Low-Tension Pole Lines," by J. C. Lawler, New York, N. Y. "The Place of Rotary Condensers and Induction Generators in Transmission Systems," by H. L. Allen, General Electric Company, Denver.

PRESIDENT N. W. ELECTRIC LIGHT AND POWER ASSOCIATION.

As mentioned in these columns last week, the newly elected president of the Northwest Electric Light & Power Association is Mr. Douglass Allmond, president

Douglass Allmond

of the Anacortes Water Co., of Anacortes, Wash. As the photograph was received too late for publication last week, it is reproduced herewith.

THE CHEMIST'S PLACE IN POWER ECONOMY

The watchword of modern industry is no longer "increased production"; it has changed to "increased efficiency of production." The day of cheap raw material is passing, if indeed it has not already gone, and industry faces a new set of conditions. Nowhere more than in the production and transmission of power are there greater opportunities for improvement—for the saving of time, and labor, and money. That the chemist ought to take the foremost part in solving the problems of power efficiency is the argument convincingly set forth in a paper read before the recent convention of the American Chemical Society by Arthur D. Little, of Boston. Mr. Little makes a vigorous presentation of the chemist's special qualification for dealing with questions of energy, and urges a stand against the customary monopolizing of power problems by the mechanical engineer.

Chemists sometimes forget, says Mr. Little, that their science deals with energy no less than with matter, and that in fact chemistry as a science began with the recognition of the principles, materials, and products of combustion

The combustion of coal is a typical chemical process. The selection of the most efficient coal and the determination of the conditions necessary for its most efficient combustion are essentially chemical problems. Chemical problems also are those arising in the manufacture of producer and illuminating gas, their utilization in gas engines, the development of power from the waste gases of the blast furnace, the adaptation of conditions to the proper handling and burning of peat, lignite and waste coal, the thermometric exploration of coal piles to forestall spontaneous combustion, smoke abatement, the control and improvement of fireroom conditions by draft regulation, flue gas analysis, temperature measurements and even the placing of firemen on the bonus basis. Taking power plant practice and the conditions of coal purchase as they stand, the properly equipped chemist should be able to increase the efficiency of power production from five to thirty per cent.

The analysis of boiler compounds as an end in itself presents little to excite enthusiasm, but when such analyses are made the means of saving $3600 a year in the power plants of a single company they take on a new and larger aspect.

The chemist who attacks the problems of power production will not hesitate to go outside the laboratory and take his property wherever he finds it. He will conduct boiler and engine tests, study the efficiency of grates and stokers, familiarize himself with the marvelous promise of the low pressure turbine as an agent in efficient power production. While straining every resource of his science to produce steam economically by the combustion of coal, is it common sense for the chemist to stop there in ignorance of the fact that the efficiency of that steam can be increased at once from twenty-five to one hundred per cent by coupling a turbine to the exhaust.

The distribution of power supplies problems no less directly within the province of the industrial chemist. He may begin with the analysis of lubricating oils. He proves his own inefficiency if he stops there. He must inform himself regarding the market prices of oils used elsewhere for similar service, the adaptability of the oils in question to application to the bearing by soaked waste, sight feeds, or gravity cups. He must be prepared to interpret his analysis in terms of practice, and to follow the oil through the plant in order to prescribe conditions which shall keep down waste. There are few plants in which the industrial chemist working along legitimate lines cannot save from twenty to sixty per cent of the entire lubrication account, while the oil analyst has to his credit merely a few figures which his client probably fails to understand.

The efficiency and life of bearing metals varies over an extraordinarily wide range. Some are merely the refuse from type foundries, others are so carefully adapted in their composition to the requirements of particular service as to show an efficiency fifteen times or more as great as that of inferior material. Here again the mere analysis means little, the practical question is "Which is the more efficient metal under the conditions imposed by practice?"

Much additional might be said regarding the opportunity before the chemist when any material concerned in power transmission is the subject of his study, whether it be leather, rubber or canvas belting, belt dressings, insulating material, trolley wire, trolley cars or trolley wheels. In every case it is within his power to create new standards of efficiency.

REDUCING THE COST OF TELEPHONE SERVICE.

Anything that means the throwing open to the general public of first class telephone service at rates which the general public can afford to pay, is of more or less immediate interest to telephone users, and to non-subscribers who would like to be users, all over the country. From this point of view the scheme of rates and the basis of rate regulation adopted by the Massachusetts Highway Commission, and made public on August 24 as its official recommendation for the Boston and suburban telephone district is of much more than local importance. The investigation by the Massachusetts Commission has occupied three years and a half, and the result has been to demonstrate that in the Boston District, and presumably in many other cities and towns, the small user of the telephone has been overcharged for the service he receives in order to balance on the company's books the waste caused by excessive use on the part of subscribers under various flat rates for unlimited calls.

After an examination of the books, it became clear that an inventory and appraisal of the telephone company's entire property must be made before there could be any adequate basis for the adjustment of rates. This appraisal, which was most minute, showed that the replacement value of the company's property was nearly 20 per cent in excess of the par value of all the certificates of indebtedness outstanding. This result disposed of the charges that the company was overcapitalized. After referring to this and other of the earlier steps in its investigation, the Commission in its finding of last week says:

"The preliminary studies indicated that a reduction of from $300,000 to $400,000 could be made in the net yearly income of your company from the metropolitan and suburban districts with entire fairness to your company, and without impairing the efficiency of the service. This would amount to a horizontal reduction of only a small percentage per telephone if applied upon each individual rate.

"The traffic study showed conclusively that the rates per call collected from individual subscribers in different classes varied from 10 cents per call to less than 1 cent per call; certain of the larger users securing calls at a cost of less than half a cent.

"Such a variation is manifestly unjust and inequitable.

"The gross collections of your company for exchange service in the entire metropolitan and suburban district was slightly less than 3½ cents for each completed call.

"It is plain, therefore, that the larger users having unlimited rates covering the whole of the suburban area, who pay from one-half a cent to 2 cents per call, are paying less than cost, and this has to be made up by the smaller users paying from 6 to 10 cents per call.

"This latter collection was necessary to enable your company to secure an adequate revenue from the subscribers in the district as a whole, but was necessary only because a proportionately few subscribers obtained their service at this extremely low and unprofitable rate, sometimes so low that it does not even pay the wages of the operator, to say nothing of the much larger expenses required for interest, maintenance, taxes, etc. The evident injustice of this condition the commission, has sought to abate.

"The commission, therefore, instructed its experts to report a schedule of rates which would not only reduce the net yearly income in the metropolitan and suburban districts from $300,000 to $400,000 yearly, but which would be founded upon a rate for small users of a maximum charge of 5 cents a message for a minimum number of guaranteed calls.

"This resulted in the experts reporting a recommendation for the establishment of zones and a new schedule of rates therein as the only practicable way by which rates can be secured to this district which are fair, proportionate and equitable.

"The establishment of zones seems the only practicable means of securing the lowest possible rates for the moderate user of calls, who only needs a limited territory.

"It is the only possible way by which any unlimited telephone service can be properly retained and an adequate revenue secured from the district without charging the loss to the smaller users, or by which the maximum rate per call can be reduced to 5 cents.

"The toll charges recommended cover as long a distance at as low a rate as seems, even in such a densely populated district, compatible with securing for the company an adequate revenue."

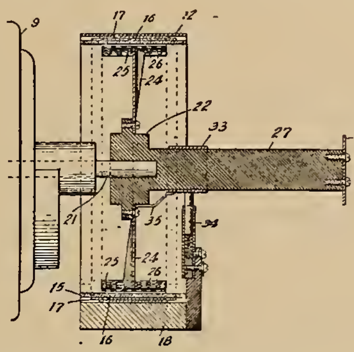
ELECTRIC VEHICLE ASSOCIATION OF AMERICA.

For the purpose of promoting the adoption and use of electric vehicles for business and pleasure, the Electric Vehicle Association of America was organized in New York City on September 1, 1910. Three classes of membership are provided, active, associate, and honorary, the by-laws further providing for branches in centers of local activity.

The newly elected officers are: President, Mr. William H. Blood Jr., of Stone & Webster, Boston, Mass.; vice-president, Mr. Arthur Williams, New York Edison Company, New York; treasurer and assistant secretary, Mr. Harvey Robinson, New York Edison Company, New York; secretary, M. C. E. Firestone, Columbus Buggy Company, Columbus, Ohio. The board of directors is composed of the following: Messrs. H. H. Rice, Waverley Company, Indianapolis, Ind.; F. W. Smith, United Electric Light & Power Company, New York City; P. D. Wagoner, General Vehicle Company, Long Island City, N. Y.; Louis Burr, Woods Motor Vehicle Company, Chicago, Ill.; F. L. Dyer, Edison Storage Battery Company, Orange, N. J.; J. T. Hutchings, Rochester Railway & Light Company, Rochester, N. Y.; Louis Ferguson, Commonwealth Edison Company, Chicago, Ill.; W. W. Freeman, Edison Electric Illuminating Company, Brooklyn, N. Y.; F. M. Tait, Dayton Lighting Company, Dayton, Ohio; H. Eames, Studebaker Brothers Company, New York, and C. Blizard, Electric Storage Battery Company, Philadelphia, Pa.

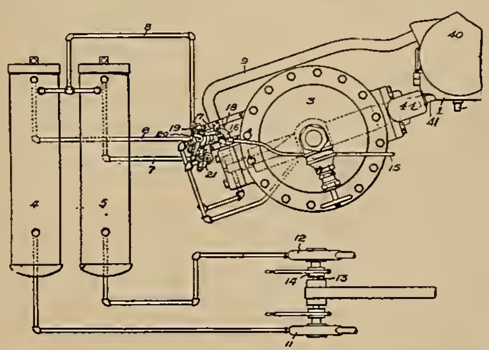
PATENTS

969,547. Ozonizer. Oscar Linder, Chicago, Ill., assignor to Standard Electro-Utilities Company. In a device of the class described, an insulating annulus, a stationary electrode surrounding the annulus and spaced therefrom a distance to create an electrical discharge between the electrodes, the ro-



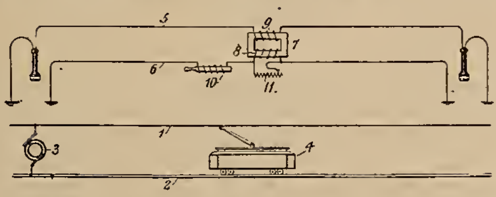
tating annulus being provided with a plurality of discharge shoes, each provided with a plurality of air holes whereby when the rotating electrode is in motion air draft will be created through said holes to remove the ozonized air from the electrodes.

969,760. Gas-Turbine. Sanford A. Moss, Lynn, Mass., assignor to General Electric Company, a corporation of New York. A gas turbine having a combustion chamber, rows of wheel buckets for abstracting the energy of the gas received from the combustion chamber, in combination with a nozzle discharging products of combustion against the buckets to



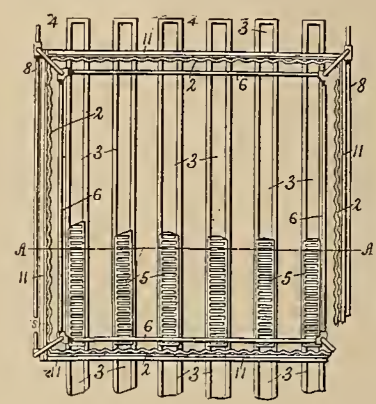
produce rotation, intermediate buckets, passages extending longitudinally through the intermediate buckets for conveying a cooling fluid to reduce the temperature, means separating the outer ends of the passages into sets, conduits that convery the cooling fluid to and from said sets, and conduit means connecting the inner ends of the passages.

969,499. Means for Neutralizing Induced Disturbances in Intelligence-Transmission Circuits. Charles F. Scott, Pitts-



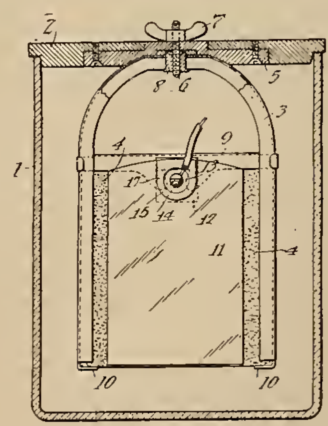
burg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The combination with two electrical circuits that are located within a magnetic field, of a transformer having a primary winding located in one of the circuits, and a secondary winding in the other, an ohmic resistance connected in shunt to the primary winding, an indicative resistance connected in series therewith, and means for adjusting the same until the resultant electromotive force in the primary circuit agrees in phase with the resultant of the electromotive forces impressed upon the secondary circuit by other means than the transformer.

969,158. Sawmill-Refuse Burner. Arthur B. Diplock, North Vancouver, British Columbia, Canada. As a means for the purpose specified, a wall inclosure of corrugated sheet metal the corrugations of which are vertically arranged, a



water pipe located at the top of the walls, said pipe being perforated to deliver a spray against them, trenches formed of brick extending across the surface of the ground which is inclosed by the walls, said trenches being extended laterally beyond the walls, and gratings over the trenches within the inclosure.

969,349. Primary Battery. Eben G. Dodge, Maplewood, N. J., assignor to Edison Manufacturing Company, West Orange, N. J. In a voltaic battery, the combination with a copper oxid plate of a hanger having depending arms supporting said plate, a cross piece connecting the arms of said hanger,



a pair of zinc plates supported by said cross piece, insulating blocks between said zinc plates and said cross piece, and a bolt passing through said insulating blocks and connecting said zinc plates, each zinc plate being formed with an annular boss on its exterior surface surrounding the adjacent end of said bolt.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

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A. H. HALLORAN, Vice President and Managing Editor
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EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electric Show

The Pacific Coast Electrical Exposition opens September seventeenth in San Francisco's new Coliseum, continuing until September twenty-fourth. This is the first electrical show to be held in the West and as such it will attract popular attention to the manifold advantages of electricity in all branches of work and of play. This show is the culmination of more than three years' endeavor on the part of the most progressive of the Pacific Coast electrical men. Undaunted by the many difficulties that have beset their path during the past year they have persevered until finally a successful exposition has been reared as a reward to their efforts.

Minor hindrances, such as the burning of the only structure in San Francisco with sufficient floor area to accommodate the show and the subsequent delay in rebuilding another on the same site, have not been as difficult to surmount as the general apathy that has unfortunately pervaded the electrical fraternity. Naturally we look to the manufacturer for the initiative in a project of this kind, but we do not expect to find indifference and even opposition from those so short-sighted as not to realize that any means of increasing the use of electricity redounds to the mutual benefit of the manufacturer, jobber, contractor and retailer, and also to the company selling the current utilized by electrical apparatus. Happily, the opening of the show nullifies these past actions and it now remains for every electrical man to do his part in making the show a success by inducing others to attend.

The success of the show depends upon a large attendance. Of course everyone in any way identified with the electrical profession and trade will attend, but they should also realize that they can stimulate outside interest by talking about the show. There will be exhibits that will appeal to all classes and all ages, labor-saving devices for men, household conveniences for women, and even electric pads and milk warmers for the babies. There are now things electrical that are indispensable to "rich man, poor man, beggar man, thief, doctor, lawyer, merchant, chief," as well as "the butcher, the baker, and the candlestick maker." People have been reading about the wonders of electricity, but here is an opportunity to actually see them and ask questions about their operation. The ultimate consumer will be there and it behooves the electrical men "to get all together, all the time for everything electrical."

The outcome of this show will have a great influence on holding similar exhibitions in the future. The Eastern electrical shows are annual affairs and the importance of the electrical industry in the West warrants a like frequency of exhibit on the Pacific Coast. All of the exhibitors have gone to a great expense in preparing their displays and must feel that they are getting value received if they are to be induced to repeat this effort. The show is not a local affair and should receive the same indorsement in the Northwest and in the South as from those communities neighboring San Francisco Bay. We therefore again bespeak the most earnest support of all Pacific Coast electrical men for this initial attempt to popularize the use of electricity on a large scale.

PERSONALS.

G. McM. Ross, an engineer of Stockton, has been spending a few days at San Francisco.

Leon H. James an engineer from the Canal Zone, was a San Francisco visitor during the past week.

Leon Bly, secretary of the Tehama Irrigation & Power Company of Red Bluff, was a San Francisco visitor last week.

H. R. Noack, of Pierson, Roeding & Co., has just returned to San Francisco from an automobile trip to Portland.

John M. Gardiner, who is connected with electric railway corporations at Los Angeles, has arrived at San Francisco.

G. H. Palmer, formerly with the Telluride Power Company, is now operating superintendent for the Arizona Power Company at Prescott, Ariz.

J. H. Wise, of F. G. Baum & Co., electrical engineers, has gone up the Yuba River on exploration work in connection with electrical development.

A. F. Dieter, secretary-treasurer of the Hydroelectric Company, has returned to his home at Bodie after visiting the company's San Francisco office.

Frank Thurber, chief electrician of the San Jose Railroads, of San Jose, was a San Francisco visitor during the Admission Day Festival last week.

L. J. Corbett has removed his offices as consulting electrical, hydraulic and mechanical engineer, from the Empire State Building to the Realty Bldg., Spokane, Wash.

D. B. Dean, manager of one of the subsidiary plants of the J. G. Brill Company, has just returned East after paying a visit to Pierson, Roeding & Co., the Pacific Coast agents.

George W. Bacon, president of Ford, Bacon & Davis, left for the East last Wednesday after spending two weeks on the Pacific and paying a visit to his firm's San Francisco office.

Arthur L. Mullergren, formerly assistant electrical engineer with Ford, Bacon & Davis and recently acting superintendent of the Poteau Light & Ice Co., of Poteau, Oklahoma, has opened offices as consulting electrical engineer in that city.

Jacob Furth, president of the Seattle Electric Company, was among the delegates from the Seattle Chamber of Commerce who recently sailed from San Francisco to visit China as the guest of the associated commercial bodies of that nation.

L. W. Storrer, who recently left the Postal Telegraph Company for a new position with the Pacific Telephone and Telegraph Company at San Francisco, has been given the title of commercial agent, and will have charge of "inter-company relations" and leased lines.

William Hoopes, electrical engineer of the Aluminum Company of America, has gone to Los Angeles after spending two weeks at San Francisco visiting with Pierson, Roeding & Co. He will make his headquarters with the Los Angeles branch office of the same firm while in Southern California.

Leon M. Hall, of Hall, Demarest & Co., has returned to San Francisco after an automobile trip to Virginia City, via Lake Tahoe and other summer resorts. He had with him as guests Captain Leale of the steamer Newark, George Wilson of Virginia City and Sidney Stone, manager of the Butters plant on the Comstock Lode.

Hugh F. McPhee, who recently became manager of the San Francisco office of the Western Union Telegraph Company, and has just been promoted to the position of District Commercial Superintendent of the Third District, with headquarters at Los Angeles, has been replaced here by W. F. Magee. The latter was formerly agent for the Santa Fe Railroad Company at Wichita, Kansas.

Newly elected associate members of the American Institute of Electrical Engineers include A. C. Campbell, chief engineer Columbia Power & Light Co., Walla Walla, Wash.; L. L. Dyer, operator in charge Pacific Light & Power Co., Redondo, Cal.; N. A. Eckart, resident engineer Snow Mountain Water & Power Co., Potter Valley, Cal.; A. H. Griswold, plant engineer, Pacific Tel. & Tel. Co., San Francisco, Cal.; H. H. Jones, manager San Diego Consolidated Gas & Electric Co., San Diego, Cal.; Albert Leigh, foreman hydroelectric substation Pacific Gas & Electric Co., Mission San Jose, Cal.; F. E. Manzer, construction foreman department of electrical engineering, Southern Pacific Railway Co., San Francisco, Cal.; W. B. Matheson, salesman Pacific States Electric Co., Los Angeles, Cal.; E. B. Miller, superintendent power plant construction Panhandle Lumber Co., Ione, Wash.; Richard Waldron Jr., electrician Board of Underwriters of the Pacific, Los Angeles, Cal.

NATIVE SONS' ELECTRICAL ILLUMINATION.

In conjunction with the celebration by the Native Sons of the Golden West of the sixtieth anniversary of the admission of California to the Union there was employed an elaborate scheme of street illumination. It was largely a duplication of the electric lighting effects adopted at the Portola celebration in October, 1909, which was illustrated in these columns at that time.

ANNUAL JOVIAN MEETING.

The eighth annual meeting of the Rejuvenated Sons of Jove will be held at Birmingham, Ala., October 13, 14 and 15. Present indications are that this meeting will be the most successful in the history of the order.

NEW CATALOGUES.

Circular No. 1175 from the Westinghouse Electric & Mfg. Co. shows the application of electric heat to the manufacture of hats, both felt and straw.

Bulletin No. 235 from the Sprague Electric Company deals with the application of Sprague round type direct current and type R alternating current motors to disc and propeller fans.

The American Electric Fuse Company, Muskegon, Mich., has issued Bulletin No. 316 on the Allen-Bradley battery charging rheostats. The rheostats are fully described and the various types illustrated. A table is given showing the maximum charging rate in amperes for which the rheostats are designed with various sized batteries.

TRADE NOTES.

C. G. Hussey & Co., operating the Pittsburg Copper and Brass Rolling Mills, have established a San Francisco office and warehouse at 565 Folsom street, in charge of A. H. Burns.

The National Fuel Appliance Co. of Los Angeles, Cal., manufacturers of the Cyclone system of fuel oil burning, have established branch offices at 17-19 Main street, San Francisco, with J. R. Douglass as manager.

Sanderson & Porter of New York City have recently contracted with the Westinghouse Electric & Manufacturing Company for two 1250 k.v.a. turbo-generators to be used in the power plant of the Federal Light & Traction Company, Denver, Colo. The generators have the following characteristics: 3-phase, 60 cycles, 2300 volts, 3600 r.p.m. Two No. 8 La Blanc condensers will be used in connection with the steam turbines. The generator fields will be excited by two 50 kw. 125 volt, 2250 r.p.m., d.c. turbo generators to be used in connection with a Tirrill regulator. The order also includes the necessary transformers, lightning arresters, disconnecting switches, and switchboard.

INDUSTRIAL

EXHIBITS AT PACIFIC COAST ELECTRICAL EXPOSITION.

American Eveready Company's exhibit will embody all types of dry batteries in course of manufacture, and also a complete exhibit of electric flashlights, electrical novelties, vacuum bottles, miniature lamps and decorative lighting outfits, spark plugs, speedometers, automatic automobile starters, windshields, tire chains and automobile accessories. Of special interest to the electrical world is the "Three Crescent" telephone battery, manufactured only in San Francisco, and at none of the other factories controlled by this concern. This battery is sold with a guarantee of an initial amperage of fifteen to eighteen, and a self depreciation of only three amperes within six months time. The "Eveready" battery used for ignition purposes is too well known to require special mention. A visit to the "Eveready" booth will more than repay those interested in things electrical and automobile.

The Dean Electric Company will have the following equipment on exhibition: A Standard private branch board that operates in connection with the automatic equipment. This private brauch board is now being used by the Home Telephone Company of San Francisco and Oakland. Common battery harmonic switchboard, together with telephones and harmonic converter and ringing machine. These will be exhibited in actual operation. A full line of Dean telephones, including late models for wayside service; that is, the hand microphone and jack system that is used for special service such as delivery wagons, taxicabs, automobiles, etc., and also the new bedside telephones. They will have in operation their Police Flashlite Switchboard, and from this switchboard will operate one of the patrol boxes, showing the method of sending in a call and operating the flash in the box whenever the desk sergeant is asked to call a patrolman. There will be in attendance at the show, in addition to Resident Engineer George A. Scoville and his office organization, M. J. Corwin, Pacific Coast sales engineer, with headquarters at Seattle, and F. M. Coker, Southern California representative, whose headquarters are at Los Angeles.

The Drendell Electrical & Mfg. Co. will have an exhibit unique in character, showing a line of locally manufactured articles, including panel and power house switchboards, and special detail apparatus. An electric vulcanizer for belts consisting of a resistance unit made of a specially baked clay unaffected by 1000 degrees C heat, and wound with a resistance wire having a special plugging in attachment at both ends of tube, will be shown. The unit itself is so designed that it can be wound for various watt capacities, in conjunction with other tubes without the use of splices, the slots along the outer side of tube terminating into receptacles, thus permitting the ready starting and finishing of ends. Theatrical apparatus as well as special connectors and wire clamps of all sizes will also be exhibited, together with high tension distributing switchboard units.

General Acoustic Company will exhibit an electrically operated contrivance for the deaf known as the acousticon.

The General Electric Company's display, 1000 square feet, will be divided into two sections. One-half of the exhibit will be devoted to a general display of current consuming devices of interest to the general public. This will include arc lamps, incandescent lamps, measuring instruments, motors, etc. In this section will be found a color booth of special interest to merchants who have to show goods of which the proper color value is essential in the selection. Every merchant should see this color booth and the effects that the various electric and gas lamps have on colored material. All of the available sizes and types of Mazda and tantalum lamps will be attractively displayed, as well as two or three of the recent developments in arc lamps. A representative line of electric motors will be on display connected up in various ways with General Electric automatic controlling and protective devices. This display will show quite clearly to the general public the adaptability of the various reliable controlling and protective devices which are now on the market. A very interesting part of the General Electric Company's exhibit will be the mercury arc rectifier especially adapted for moving picture theaters. This rectifier outfit has become exceedingly popular among the moving picture men on the Pacific Coast, and in order to show it properly in operation it will be connected to a stereopticon lantern through which attractive views will be shown all during the exposition. The other section of the General Electric Company's exhibit will be fitted up as a model electrical dining room and kitchen for an interesting display of electrically heated cooking devices, as well as convenient and economical labor saving devices for the home. This portion of the exhibit will be under the supervision of a competent demonstrator, and will unquestionably prove of great interest to the general public. Cooking by electrically heated devices is not a luxury, as will be proven unquestionably in the experience of the next few years. The devices exhibited at the exposition will, within a very short time, be a necessity in every home.

The Kellogg Switchboard & Supply Co. will exhibit a full line of standard telephone exchange equipment for rural and city exchanges, together with special apparatus designed for railways, mines and power companies. An interesting feature will be telephone train despatching equipment, such as is being used on the majority of the railways. In addition to the exhibit at the Coliseum the Kellogg Company also expects to exhibit to its out of town customers and friends the complete toll boards which have recently been installed for the toll suburban service of the Bay Cities Home Telephone Company.

Charles L. Kiewert will display a complete line of flaming and carbon arc lamps and supplies, including the Siemens flaming arc and the Aurola, Alba, Triplex, Economy and Lilliput arcs. A show window containing colored goods is to be lighted by a Trucolor arc and their "B 10" carbons for projecting purposes will be shown in a moving picture machine. Crocker-Wheeler motors, generators and dynamos of all types are to be exhibited, including a motor-driven printing press turning out a newspaper every day during the show, giving news items and happenings at the exposition.

Levy Electric Company will show moving pictures in which a lady is seen telephoning to them an order to repair some lights. Their operator is seen taking the order, another man receives the order and goes on his motor cycle with the material necessary to do the work. He is seen coming up the street, running up the stairs, ringing the bell and going into the house. The next picture shows him finishing the repairs on the washer machine when the machine is running. In addition to this, slides of their stores and some of their work will be shown, their idea being to advertise the repairing department, believing that the selling of goods and the use of utensils will be shown by other exhibitors. They will, however, have a demonstrator on the Arnold Vibrator, washer machine and sewing machine, also wireless goods and a general line of electrical supplies for the retail customers as carried in their three stores.

National Dictograph Company will have a working exhibit of the dictograph, an instrument used for communication, dictating letters to stenographers, issuing orders to various business departments simultaneously and transmitting music and opera from theaters to distant points.

Standard Underground Cable Company's exhibit will include coils and reels of bare and insulated copper wire, lead covered cable, bare and insulated copper clad wire, Davis Open Air and Davis Station Terminals, insulating compound, insulating tape, manhole cable supports and other cable accessories. They will be represented by A. B. Saurman, E. K. Preston, W. G. Stearns and L. A. Nott.

The Telephone-Electric Equipment Co. will feature three well known lines as follows: Telephones and apparatus manufactured by the Stromberg-Carlson Tele. Mfg. Co., of Rochester, N. Y., should be of particular interest to architects and contractors as they will feature in this line intercommunicating telephone apparatus which is designed for use in the highest class of residences and commercial systems. Simplex Electric Heating Company's line of household electrical cooking and heating devices and also their line of commercial appliances will be well represented. This line should be of interest to all, not only the dealer, but also the consumer. The Holtzer-Cabot line of telephones, annunciators, small motors and a variety of electrical specialties will also interest architects and contractors. Those in charge and in attendance at the exhibit will be Mr. Arthur E. Rowe, Mr. H. E. Bittmann, and Mr. S. L. Hawken.

Westinghouse Electric & Mfg. Co. have 1000 square feet at the intersection of the main aisles, in the center of the building. The industrial and power department will feature motor driven appliances, operated by Westinghouse motors, consisting of vacuum cleaners, ice cream freezers, buffers, grinders, polishers, sewing machines, washing machines, drilling machines, meat choppers and grinders, small refrigerating plants, blacksmith blowers, ventilating and suction fans, direct connected and marine steam-electric sets, and a complete line of every type of motor manufactured by this company. They will also exhibit a miniature oil well derrick complete in every detail, showing the operation of pumping, pulling and drilling oil wells by especially designed Westinghouse motors.

The detail and supply department will show a complete line of transformers, oil circuit breakers, switches and kindred apparatus. Domestic heating appliances will be featured by an operator from a local clothing manufacturer, demonstrating the advantage of the automatic tailors' iron. The toaster stove will be demonstrated by a pretty little Miss (strictly juvenile), dispensing delicious toast right off the grid. The lamp department will show on two revolving discs, all types and sizes, both low and normal voltages being supplied on each rack. A model street series tungsten system will also be displayed.

The department of publicity will be represented and featured by the display of a model billboard showing street car ads, art posters, folders, ad. books, flyers, special publications, booklets, postal cards and other forms of advertising literature furnished free to patrons.

The rear section of the booth will be reserved for a reception space, this being fitted with chairs, tables, divans, palms, for the comfort of visitors. In one corner will be a mantle, in the fireplace of which will be displayed a luminous radiator. The Techau Tavern will also display in the reception room, a model dining table, graced by an electric fountain in operation, also showing a chafing dish and toaster stove.

G. F. Haller of the Westinghouse Company will operate some electric signs with high voltage and frequency current. Mr. Haller will also perform some novel electrical stunts in the way of handling this current at 150,000 volts and 102,000 cycles, illuminating Gisler tubes, lighting cigars from his finger tips, etc.

This exhibit is given under the direction of W. W. Briggs, manager of the San Francisco office, and supervised by T. E. Collins, manager of the detail and supply department. The following salesmen of the San Francisco office will be in attendance during the exposition: Messrs. J. G. DeRemer, C. E. Heise, L. A. Somers, H. H. Daley, N. K. Cooper, W. R. Dunbar, C. D. Herbert, J. E. Bridges, J. J. Pottinger, R. A. Balzari, H. S. DeLancie.

HOME TELEPHONE DIRECTORY OF EXHIBITORS AT PACIFIC COAST ELECTRICAL EXPOSITION.

September 17 to 24, 1910.

American Steel and Wire Co.	16th and Folsom	M2121
John R. Cole Co.	766-70 Folsom	J1400
H. W. Johns-Manville Co.	159 New Montg'y	J1751
Aylesworth Agencies Co.	143 Second St.	J4405
American Ever-Ready Co.	755 Folsom St.	J3268
American Electric Fuse Co.	143 Second St.	J1193
Burroughs Adding Machine Co.	200 Kamm Bldg.	J1329
Baker & Hamilton	433 Brannan	J3416
Bay Cities Electric Co.	1554 Van Ness	C6569
Brumfield Electric Sign Co.	18 Fell	J2119
Collins Wireless Tel. Co.	Newark, N. J.	
City Electric Co.	347 Grant Ave.	C1632
Dean Electric Co.	2d and Natoma	J2069
Drendell Switchboard & Supply Co.	169 Erie	M1260
Daggett, R. B. & Co.	1630 Van Ness	C3684
DeLux Electric Sign Co.	747 Phelan Bldg.	C4049
Elec. Ry. & Mfrs. Sup. Co.	84-86 Second	J1299
Engineering & Mtce. Co.	195-7 Fremont	J2225
Elec. Review & Western Electrician	Chicago	J1414
Electrical World	New York	J1414
Frosch, H. F. Co.	171-73 Second	J1985
Ft. Wayne Elec. Co.	404 Atlas Bldg.	J1637
General Acoustic Co.	554 Monad. Bldg.	J1637
General Electric Co.	Union Trust Bldg.	C5856
Gray Telautograph Co.	New York	
Home Telephone Co.	333 Grant Ave.	C03
Journal of Electricity, Power & Gas	604 Mission St.	J1414
Kellogg Switchboard & Supply Co.	88 First St.	J2793
Kohler & Chase	28 O'Farrell	C4271
Levy Electric Co.	648 Sacramento	C1185
National Dictograph	554 Monad. Bldg.	J1524
National Elec. Lamp Ass'n	Oakland W'house	A1633
Otis & Squires	155 New Montg'y	J3430
Parrott & Co.	320 California	C4171
Pac. Elec. Mfg. Co.	80 Natoma	J2164
Pierson-Roeding Co.	407 Monad. Bldg.	J3381
Paraffine Paint Co.	34 First	J2785
S. F. Compressed Air Co.	Sutter and Stockton	C5852
Studebaker Bros.	Mission and Fremont	
Southern Pacific Co.	Flood Bldg.	C3111
Sprague Electric Co.	404 Atlas Bldg.	J1637
S. F. Gas & Electric Co.	445 Sutter St.	C6340
Standard Underground Cable Co.	1st Nat'l Bank Bldg.	C4231
Tel. & Elec'l Equipment Co.	612 Howard	J2331
Walters Surgical Co.	393 Sutter St.	C5651
Westinghouse Elec. & Mfg. Co.	163 Second St.	J3041
Ideal Electric Co.	1665 Van Ness	S4542
Weston Electric Equipment Co.	684 Mission	J1336
Department of Electricity	55 Fulton St.	J3136

APPROVED ELECTRICAL DEVICES

CABINETS.

"Noark" Service Entrance Boxes. Cast iron boxes containing 2 or 3 pole porcelain or slate cutout bases for N. E. Code Standard cartridge enclosed fuses. Covers of boxes fitted with attachments whereby opening of box may cause fuses to be withdrawn. "Watertight" Style, 61-100 A., 250 V., Cat. Nos. 3678-3685 incl., 0-60 A., 600 V., Cat. Nos. 5868-5871 incl. "Weatherproof" Style with porcelain base knife switches with extensions for Edison plug fuses, c-30 A., 125 V., Cat. Nos. 3665 and 3666. "Noark" Fuse Boxes. All capacities, 250 and 600 volts. "Watertight" Style, 250 volts, Cat. Nos. 3670. 3677 incl., and 600 volts, Cat. Nos. 5760-5767 incl. "Weatherproof" Style, with porcelain base cutouts for 250 volts, Cat. Nos. 3810-3815 incl.; for 600 volts, Cat. Nos. 5850-5855 incl. "Weatherproof" Style, with porcelain or slate base branch cutouts, 0-100 A., 250 V. only, Cat. Nos. 3840-3842 incl. and 3860-3862 incl. Approved for use with conduit system, August 30, 1910. Manufactured by

The Johns-Pratt Company, Hartford, Conn.

Panelboard Cabinets. Sheet iron with slate gutter and slate lined oak trim and door. "Schrimp Box." Cast iron cabinets for enclosing approved cutout bases, with or without branch switches. Cat. Nos. 501-511 incl. Approved August 13, 1910. Manufactured by

The Newport Electric & Mfg. Co., Newport, Ky.

FIXTURES.

"Mazda" four light, cluster fixture consisting of a crowfoot support, conduit stem and an enameled canopy reflector having four lamp receptacles extending through the top of the canopy with open wiring supported 1 inch above the upper surface. Approved August 30, 1910. Manufactured by

American Arc Lamp Co., Kalamazoo, Mich.

GROUND CLAMPS.

"Yonkers." A two-piece cast iron clamp for use with sheet steel outlet boxes, one part serving as a nut for a set screw which clamps the conduit or gas pipe and at the same time holds the clamp in the box opening by a wedge action when the screw is set up tight. Approved August 19, 1910. Manufactured by

Westchester Electrical Equipment Co., 34 North Broadway, Yonkers, N. Y.

HANGERBOARDS, ARC LAMPS.

"Perkins," Cat. Nos. 3226 (with plug fuse receptacles) and 3269 (with double pole ceiling switch and plug fuse receptacles). The switches are approved and labeled under the conditions stated on card 1464-A., dated April 15, 1910, filed Switches, Surface Snap. Approved August 25, 1910. Manufactured by

The Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

HEATERS, ELECTRIC.

"Westinghouse" heating devices, 100-125 V. Glue Pots, Style Nos. 102770-102777 incl. Disc Stoves, Style Nos. 121817-121819 incl. Toaster Stoves, Style Nos. 102941-102943 incl. Approved August 30, 1910. Manufactured by

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

MISCELLANEOUS.

"Benjamin" Tungsten Shock Absorber, consisting of a fixed metal yoke within which a movable threaded sleeve for supporting the fixture is assembled with a coiled wire spring. Cat. Nos. 3350, 3340 with canopy support. Approved August 25, 1910. Manufactured by

Benjamin Electric Mfg. Co., 120-128 S. Sangamon St. Chicago, Ill.

MOULDING FITTINGS.

Fittings for use with "National" metal moulding. Crosses, Cat. No. 334. Tees, Cat. Nos. 335, also 405 and 411 (moulding to conduit). Elbows, Cat. Nos. 336, 337 338 also 403 (moulding to conduit). Couplings Cat. Nos. 344 (base) 402 (moulding to conduit) and 404 (moulding to open work). Clamps, Cat. Nos. 345, 354 and 355 (ground). Rosettes, Cat. Nos. 348 and 362. Outlet Bushings, Cat. No. 356. Panel Box Connectors, Cat. No. 401. Fixture Studs, Cat. Nos. 406-409 incl. Approved August 16, 1910. Manufactured by

National Metal Molding Co., Fulton Bldg., Pittsburg, Pa.

MUSICAL INSTRUMENTS.

"Choralcelo" Electrical Piano. In this instrument 25 volt current from a battery or motor-generator set passes through a special interrupting device to magnets, resistances and contacts in piano case. This current serves to cause the piano strings to vibrate. Interrupter and associated devices are inclosed in fireproof case. Motor generator in metal case. Special cable from interrupter to piano. The electrical portions of this instrument are judged to be as well safe-guarded as can be demanded in an instrument of this type. Before installation application should be made to Inspection Department having jurisdiction for directions for installing in accordance with rules governing Low Potential Systems. Approved August 25, 1910. Manufactured by

Choralcelo Mfg. Co., 33 Broad St., Boston, Mass.

RECEPTACLES STANDARD.

"Arrow E" brass shell wall sockets. Key, "Standard" Cat. Nos. 9184 and 50753, "Twenty-point" 104840 and 104842. Keyless "Standard" Cat. Nos. 9185 and 50755, "Twenty-point" 104841 and 104843. Pull, "Twenty-point" Cat. Nos. 104844 and 104845. Sign, Cat. Nos. 59108, 68027-68029 incl. Cleat, Cat. Nos. 9402 11221 and 28795. Approved August 20, 1910. Manufactured by

The Arrow Electric Company, 630 Capitol Ave., Hartford, Conn.

"G. E." key and keyless types. Wall Sockets, brass shell. Key, Cat. Nos. 9184, 27742, 28721 (slotted or closed base), 29404, 29406, 50753, (slotted or closed base), and 60018, also 88959 (for use on metal ceilings). Keyless Cat. Nos. 9185, 27743, 28722, 29405, 29407, 50755, 60019 and 60020, also 88960 (for use on metal ceilings). Porcelain shell, keyless 3 A., 250 V. Cleat type, Cat. Nos. 11221, 28794, 28795, 50715, 59275, and 61039Concealed type, Cat. Nos. 49355, 50717, 50744, 100600, 100601. Also 50752, fused, 2 A. 125 V. Moulding types, Cat. Nos. 34152, 58303 and 100266. Conduit Box, Cat. Nos. 9397, 9514, 40537, 49354, 60931, 62357 and 103155. Sign Receptacle, Cat. Nos. 46627, 105000. Approved August 30, 1910. Manufactured by

General Electric Company Schenectady, N. Y.

"C. S. K." 660 W., 259 V. Conduit Box Receptacles, HK No. 1, 2 and 3. Approved August 30, 1910. Manufactured by

C. S. Knowles, 7 Arch St., Boston, Mass.

Wall Sockets. Brass Shell. Key, Cat. Nos. 60430, 61066, 61067, 61068, 61387 (387), 61455 (455), 62350, 103075 and 104606. Keyless, Cat. Nos. 60387 (0387), 60431, 61456 (456), 62351 and 104600. Porcelain Shell. Key, Cat. Nos. 61087 (1087), 61237 (237), 62247 (247), and 62371 (2371). Keyless, Cat. Nos. 60237 (0237), 60247 (0247), 60371 (02371) and 61107 (107). Approved August 16, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

"Circle T," 250 W., 250 V. Conduit box receptacle, Cat. No. 976. Moulding receptacle, Cat. No. 995. Approved August 19, 1910. Manufactured by

The Trumbull Mfg. Co., Plainville, Conn.

"P. & S." 3 A., 250 V. Cleat, Cat. Nos. 61870 (870), 61871 (871), 64369 (821), and 66612 (822). Moulding, Cat. Nos. 61670 (670), 61770 (770) and 100136. Sign or Conduit Box Type, Cat. Nos. 975, 61072 (1072), 61777 (777), 61973 (973) and 61977 (977). Removable ring types, Cat. Nos. 61577 (577), 61578 (578), 61877 ((877), 61988 (988), 102793, 102704. Also 61900 (900) for use only in borders of double faced metal panel signs, and 61960 ready wired for sign work with receptacles spaced 4 inches on centers. This receptacle is also furnished wired with No. 12 or No. 14 wire and with spacings 5-30 inches on centers. Condulet Receptacle, Cat. No. 88259. Conduit Box Type, Cat. Nos. 10, 9514, 50717, 62357, 103704 and 104603. Approved August 22, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

RECEPTACLES, WEATHERPROOF.

"P. & S." 660 W. 250 V. Cat. Nos. 61160 (1160), 61161 (1161), 61163 (1163), 61972 (972), 61974 (974), and 62358 (872). Also Cat. No. 61971 (971) for use only when installed where exposed to rainfall. Approved August 22, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

ROSETTES, FUSELESS.

"Arrow E" 3 A., 250 V. Moulding, Cat. No. 1300. Cleat, Cat. No. 920. Approved August 29, 1910. Manufactured by

The Arrow Electric Company, 630 Capitol Ave., Hartford, Conn.

SIGNS, ELECTRIC.

Sheet metal closed boxes forming a single letter or a sign casing upon which lamp receptacles are mounted for wiring inside the enclosure. Approved, when properly mounted on suitable frames, July 25, 1910. Manufactured by

Greenwood Advertising Company, 511-515 State St., Knoxville, Tenn.

SOCKETS, STANDARD.

"Arrow E" brass shell sockets. Key, Cat. Nos. "Two-point," 104850, 104851, 104854, "Twenty-point" 104870, 104871, 104875, "Sixty-point," 68030, 68031, 68036, "Standard" 9836 and 50760. Keyless Cat. Nos. "Two-point" 104852, 104853, 104855, "Twenty-point" 104872, 104873, 104875, "Sixty-point" 68032, 68033, 68037, "Standard" 9392 and 50768. Pull Cat. Nos. "Two-point" 104860, 104861, 104862, "Twenty-point" 104880, 104881, 104882, "Sixty-point" 104800, 104801, 104802. Also the above types with shadeholders attached. Approved August 25, 1910. Manufactured by

The Arrow Electric Company, 630 Capitol Ave., Hartford, Conn.

"G. E." porcelain shell sockets. Key, Cat. Nos. 9395, 34947, 50799 and 100596. Keyless, Cat. Nos. 9393, 34948, 50896 and 100598. Approved for use only in places where they will not be exposed to hard usage, August 3, 1910. Manufactured by

General Electric Company Schenectady, N. Y.

"Weber" brass shell sockets. Key, 250 W., 250 V. Cat. Nos. 1010, 1012, 1014, 1016, 1018, 1020, 61372, 61373, 61573 and 61773. Keyless 660 W. 250 V. Cat. Nos. 1011, 1013, 1015, 1017, 1019, 1021, 61374, 61375, 61575 and 61775. Also the above types with shadeholders attached. Approved August 13, 1910. Manufactured by

Weber Electric Company, Schenectady, N. Y.

"P. & S." 660 W. 250 V. Composition Shell, Cat. Nos. 43310 and 60666. Porcelain shell, Cat. Nos. 9366 (116), 9448 (6116½) and 9496 (116½). Also 61418 (418) for festoon work, and 61420, ready wired for decorative work with sockets spaced four inches on centers and with insulated suspension cleat and hook Cat. No. 430. This socket is also furnished wired with No. 12 or No. 14 B. & S. gage wire and with spacings on centers of 5-30 inches. "P. & S." 660 W. 600 V. Porcelain shell, Cat. No. 80, for use with incandescent lamps in series on 600 V. circuits. Approved August 25, 1910. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

SWITCHES, AUTOMATIC.

"Watson Stillman" Automatic Tank Switch, 10 A., 250 V., a single pole, double break knife switch, the blade of which is operated by a heavy pivoted sector controlled by means of a pulley carrying a chain to which a ball float and counterweight are attached. Switch enclosed in heavy cast metal case. Approved August 26, 1910. Manufactured by

The Watson Stillman Co., 50 Church St., New York, N. Y.

SWITCHES, COMBINATION CUTOUT.

"Noark" Service Entrance Switches. Cast iron boxes containing 2 or 3 pole porcelain or slate cutout bases for N. E. Code Standard cartridge enclosed fuses. Covers of boxes fitted with attachments whereby opening box may cause fuses to be withdrawn. "Watertight" Style, with porcelain base knife switches with extensions for Edison plug fuses, 0-30 A., 125 V., Cat. Nos. 3665 and 3666. Approved for use with conduit systems, August 30, 1910. Manufactured by

The Johns-Pratt Company, Hartford, Conn.

SWITCHES, FIXTURE.

"Junior Pull Switch," 3 A., 125 V., 1 A., 250 V., Cat. Nos. 371, 372 and 373. An adaptation of the standard Bryant pull socket mechanism for attachment to 1-8 inch pipe, or to canopies, clusters and chandeliers. Approved August 12, 1910. Manufactured by

The Bryant Electric Company, Bridgeport, Conn.

SWITCHES, KNIFE.

Single, double and three-pole, mounted on slate bases, with or without N. E. Code standard cartridge enclosed fuse extensions. Type A, 0 to 200 A., 250 V., 0 to 60 A., 600 V. Type C, 0 to 100 A., 250 V., 0 to 60 A., 600 V. Approved August 13, 1910. Manufactured by

New Haven Electric Mfg. Co., North Haven, Conn.

SWITCHES, SURFACE SNAP.

The following switches are approved and labeled under conditions previously stated: (With Metal Covers) Single Pole, 3 A., 250 V., 5 A., 125 V., Cat. Nos. 6100-6103, inclusive, 6200-6203, inclusive, 6350 and 6351. Single Pole, 5 A., 250 V., 10 A., 125 V., Cat. Nos. 6204-6207, inclusive. Double Pole, 5 A., 250 V., Cat. Nos. 6208-6211, inclusive, 6352 and 6353. Double Pole, 10 A., 250 V., Cat. Nos. 6215-6218, inclusive. Three Way, 1 A., 250 V., 3 A., 125 V., Cat. Nos. 6223 and 6224. Three Way, 3 A., 250 V., 5 A., 125 V., Cat. Nos. 6225, 6226, 6354. Three Way, 5 A., 250 V., 10 A., 125 V., Cat. Nos. 6229 and 6230. Four Way, 2 A., 250 V., 5 A., 125 V., Cat. Nos. 6231 and 6232. Two Circuit, 2 A., 250 V., 5 A., 125 V., Cat. Nos. 6233-6236, inclusive; Three Circuit, 2 A., 250 V., 5 A., 125 V., Cat. Nos. 6237-6240, inclusive. Also all the above types with lock attachment. See also card 2310-C. Approved August 11, 1910. Manufactured by

Arrow Electric Company, 630 Capitol Ave., Hartford, Conn.

"Perkins" 15 A., 250 V. Special heater switch. Approved August 16, 1910. Manufactured by

The Perkins Electric Switch Co., Bridgeport, Conn.

Single Pole, 3 A., 240 V., 5 A. 125 V., Cat. No. 300. Approved August 20, 1910. Manufactured by

The Trumbull Electric Mfg. Co., Plainville, Conn.

TRANSFORMERS.

Air cooled transformer for indoor or outdoor use. Type N. D., Form 6. Primary volts 110-220, Secondary volts 10, Capacity 1000 watts. Approved only when installed and wired in both primary and secondary circuits in accordance with the Rules for Class C. Wiring, Nat'l Elec. Code, August 12, 1910. Manufactured by

Fort Wayne Electric Works, Fort Wayne, Ind.

WIRES, WEATHERPROOF.

Tag on coil to read "Nat'l Elec. Code Standard." Approved August 19, 1910. Manufactured by

The National Conduit & Cable Co., Hastings on Hudson, N. Y.

NEWS NOTES

FINANCIAL.

YACOLT, WASH.—The Council has passed an ordinance proposing to the voters of Yacolt that it construct and operate a gravity water system from Big Creek in Clarke county, Wash., providing for the payment by the issuance of $5800 bonds.

GRANITE FALLS, ORE.—The election held in Granite Falls decided in favor of the issuance of $13,000 in bonds to install a waterworks system, with a reservoir upon Iron mountain, three-quarters of a mile from the town and 240 feet above the townsite.

OCEANSIDE, CAL.—The City Council passed an ordinance calling a special election to be held here on September 14th to submit to the voters the proposition of voting bonds in the sum of $20,000 for the purpose of extending and improving the present waterworks and water system.

SAN BERNARDINO, CAL.—Believing that electric light service is costing too much in this city the San Bernardino Merchants' Protective Association is urging a municipal plant. At their last meeting they passed a resolution calling upon the charter revision committee to submit to the people an amendment to do away with the bonding limit entirely or extending it to 15 per cent valuation in order that a municipal plant may be built.

INCORPORATIONS.

PORT TOWNSEND, WASH.—The Olympic Power & Development Company has been incorporated by Thos. T. Aldwell, with a capital stock of $1,000,000.

RIVERSIDE, CAL.—The North Acres Pumping Company has been incorporated by L. R. Perry, Eva R. Perry and J. E. Wherrell, all of this city, with a capital stock of $9000.

MARTINEZ, CAL.—The Union Water Company of California has been incorporated by W. T. Barnett, C. C. Sullivan, E. T. York, A. S. Grant and V. W. Vincent, all of San Francisco, with a capital stock of $1,000,000.

BAKERSFIELD, CAL.—The Midway Light & Power Company has been incorporated by H. L. Dearing and Herbert Williams of Los Angeles, E. F. Hughes of Sierra Madre, H. J. Gonge and C. L. Chandler of Alhambra, Cal., with a capital stock of $250,000.

ALAMEDA, CAL.—The Sunset Power Company of Alameda, is the name of a new corporation which has just filed articles of incorporation here. The company is capitalized at $500,000 and is interested in mining and power propositions in Placer county. The directors are C. B. Greeley and Theodore Turner, of Alameda and William L. Boos of San Francisco.

ILLUMINATION.

TWIN FALLS, IDAHO.—E. Miller of Vinton, Iowa, and Eastern associates have asked for a franchise for a gas plant to be installed here at the approximate cost of $75,000.

SALINAS, CAL.—John M. Gardner, vice-president of the Monterey County Electric Light & Power Company is looking over the local plant with a view to making improvements.

FREEWATER, ORE.—The Council has passed an ordinance granting to the Pacific Power & Light Company the right to construct, maintain and operate an electric light and power plant in the city of Freewater, Oregon.

SAN FRANCISCO, CAL.—The Downtown Association has undertaken to beautify and embellish the downtown district. It has installed 140 electroliers at a cost of $16,000. These electroliers were designed and the lighting planned by local engineers and architects.

EUGENE, ORE.—The Northwestern Corporation which owns the local gas plant, announces that it is ready to extend the mains from here to Springfield if the Council will grant the company a franchise. To pipe the gas to Springfield will require a line over two miles long.

SANTA BARBARA, CAL.—A contract for the building of an addition to the power house of the Santa Barbara Gas & Electric Company has been let to J. M. Williamson at $7709. The building is to be 50x100 feet, one story in height, with brick walls and galvanized iron roof.

PORTLAND, ORE.—Directors of the Pacific Power & Light Company, now inspecting their holdings in the Northwest, have decided to spend at once something like $500,000 or $600,000 for the construction of 200 miles of electrical transmission lines in Eastern Oregon and Washington.

LOS ANGELES, Cal.—The Los Angeles Gas & Electric Company have contracted with the Western Boiler Works, contractors, to erect one 42-inch blast line, with shut off valves and relief valves, same to present main-blast piping and blast piping of oil gas generator sets No. 15 and 16 and cast iron nozzles of Kerr Turbine No. 4½, Sirocco gas blowers, complete, and ready for service for owner at corner of Aliso and Center streets, for $2350.

LOS ANGELES, CAL.—The City Council passed an ordinance to order the furnishing of electric current for lighting ornamental cast iron lighting posts located on Main street between Manchessault and Pico streets. Also an ordinance to order electric current to be furnished for lighting ornamental cast iron lighting posts on Hill, Fifth, Olive and Sixth streets, and an ordinance to order electric current to be furnished for lighting of ornamental cast iron lighting posts located on Fourth street, from Main to Hill.

PORTLAND, ORE.—The Portland Gas & Coke Company will expend approximately $500,000 on improvements during the next year and already plans have been made by the Pacific Power & Light Company, another of the Electric Bond & Share Company's enterprises, to expend a like amount on power transmission lines in the Columbia and Yakima valleys. Other improvements and extensions will be settled upon after the return of S. Z. Mitchell, president of the Electric Bond & Share Company, of New York, to Portland. A transmission line will be built from Pasco to Lind, and will there connect with the Washington Water Power Company's service. The plant at Walla Walla will be enlarged and the system extended. No plans have been made as yet for the extension of the street railway system.

BAKERSFIELD, CAL.—The Moron Electric Company is to be taken over by J. Q. Anderson and associates, who some weeks ago, entered into negotiations for the Maricopa electric plant. A deal was made by which the local plant will be made part of the system as soon as the transaction is completed, which is now beyond question. The new company's plans embrace a much more extensive service than that at present given by the plants in Taft and Maricopa. These plans will be put into effect as soon as possible, but in the meantime the present equipment will be used. During next week the company will have a crew of men here repoling and re-wiring the local system, which will be "tied in" with the line from Maricopa. As soon as this is done a

day and night service will be given, which will supply both power and light. The system is to embrace three units or generating plants—two at Maricopa and one here. The local plant is to be of 500 h.p. capacity, the idea being to distribute the juice throughout the fields. The three units will insure continuous service, as, in case of accident to one, the others can be called upon instantly. It is proposed to use natural gas in the engines, a cheaper fuel than distillate.

TRANSMISSION.

TONOPAH, NEV.—The Johnnie Mining Company at Johnnie, controlled by A. D. Myers and associates will erect a power plant at Amargosa station from which power will be transmitted to the mine, 13 miles away.

BANNING, CAL.—The Consolidated Reservoir & Power Company is progressing nicely with its work to divert the water of Whitewater river to land owned by this company north of town. Two or three electric power houses will be built along the diverted stream.

ONTARIO, ORE.—At a meeting of the directors of the Malheur County Fair authority was given the electric light company to install a line to the fair grounds for the purpose of supplying electricity over the grounds. A motor will be installed as soon as the electric wires are in place from the well drilled there a short time ago. A storage tank for water will be built on a tower about 26 feet above the ground, and this will furnish sufficient force to pipe water to all parts of the grounds.

STOCKTON, CAL.—The Sierra and San Francisco Power Company, the holding corporation for the United Railroads of San Francisco and owning the power system which was built in Tuolumne county a few years ago by the Union Construction Company, financed by the Knickerbocker Trust Company of New York, is planning to supply the southern section of San Joaquin county with electric power for all purposes. The company has ordered from the east two transformers, which will be installed at Manteca or Escalon to reduce the voltage from 100,000 to 15,000 for commercial uses. The company is now building a second transmission line from the headwaters in Tuolumne county to San Francisco and planning to equip the system so that a break in either line will not interfere with the supply of electricity at any point.

SAN FRANCISCO, CAL.—Henry A. Lardner of J. G. White & Co., the construction company in charge of the power plant at Crane Valley for the San Joaquin Power Company, Crane Valley, and other representatives of both companies, formally turned on the power for the first unit of 5000 h.p. last week. For the remaining two units of 5000 h.p. contracts for the generators from the General Electric Company have been signed and the papers for the purchasing of the water wheels have been prepared. These units will be of the same type as those now ready. The work on the auxiliary steam plant at Bakersfield is getting along in good shape. Mr. Wishon is so enthusiastic and is so anxious to handle a large current load that the San Joaquin company will soon have power enough to handle any large development plans they may undertake. The second unit will be ready for cutting in a few days. The two units to complete the plant will be completed probably in the spring.

TRANSPORTATION.

STOCKTON, CAL.—An ordinance has been passed granting to the Central California Traction Company a franchise to construct a railroad over certain streets of the city.

POMONA, CAL.—A contract for laying steel rails for the Pacific Electric Railroad between Claremont and Upland has been let to H. C. Dunn of Los Angeles, and next week the contractor will start the work.

LOS ANGELES, CAL.—The Los Angeles Railway Company has authorized a bond issue of $15,000,000. These bonds will cover improvements now under way and extensions that are needed to supply the increased traffic of Los Angeles.

PHOENIX, ARIZ.—Work is to be commenced at once on a street railway extension up Second avenue on the basis of a subsidy that calls for the tapping of the newly opened residential property in the northwestern part of the city. The new Glendale electric railway extension will be built as soon as the right of way and agreements are completed.

LOS ANGELES, CAL.—A delegation of 50 property owners appeared before the public welfare committee last week and protested against the proposed construction of car barns on a strip of land along Santa Barbara avenue which they desire to be added to the park. It was suggested by the city that a committee of property owners representing 25 per cent of the frontage to be assessed and favoring the condemnation of the strip for park purposes, enter a petition.

LOS ANGELES, CAL.—Two petitions of Huntington interests for franchise privileges have been presented to the Council and referred to the Board of Public Utilities. One is for a 20-year franchise on San Pedro, between Seventh and Aliso, and the other for a 21-year franchise extending from Sixth and Alvarado streets, thence south on Alvarado to Hoover, thence on Hoover to Jefferson, thence on Jefferson to Central, thence on Central to Vernon avenue and east on Vernon to Santa Fe avenue.

LOS ANGELES, CAL.—Directors of the Pasadena Rapid Transit Company have called a meeting of stockholders to be held October 18, to create a bonded indebtedness of $3,000,000. This money will be used to purchase rights of way, depot sites, terminals and other real property, and for building a railway between Pasadena and Los Angeles, including bridges, tunnels, power houses, stations and other structures, and for purchasing rolling stock, motors and machinery of every kind. The denomination of the bonds is left to the directors to determine. They will run for 50 years and bear 5 per cent interest. The indebtedness is to be secured by a trust deed of all the property of the corporation.

WATERWORKS.

SEATTLE, WASH.—Arrangements are being made by the Burlington Commercial Club for the installation of a city water plant estimated to cost $6000.

SULTAN, WASH.—The Sultan town council has ordered a new advertisement for bids for building the water works, the bids to be opened at the next meeting.

CULDESAC, IDAHO.—The City Council has called an election for October 4 to vote on the proposition of issuing bonds to put in a water system and electric plant.

PORTLAND, ORE.—The Pacific Power & Light Company is said to be considering the purchase of several large tracts of land in the Middle Columbia River basin in furtherance of its purpose to make a specialty of furnishing electric power for irrigation pumps.

MERCED, CAL.—The San Joaquin Light & Power Company force here is rushing the setting of the new pole lines throughout the town. As soon as the first battery of wells are finished, a pumping plant will be installed and connection made with the electric power line.

TWIN FALLS, IDAHO.—The members of the water committee which held a meeting at the Commercial Club rooms, have investigated two or three sites for weeks in the hills south of Twin Falls and is now engaged in securing estimates on the probable cost of piping the water from the well and putting in a complete city water system.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 13 | SAN FRANCISCO, SEPTEMBER 24, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXV — SAN FRANCISCO, SEPTEMBER 24, 1910. — NUMBER 13

PACIFIC COAST GAS ASSOCIATION[1]

PRESIDENT'S ADDRESS

As president of the Pacific Coast Gas Association it is my pleasant duty to welcome you to our 18th annual meeting, and as a resident of Los Angeles I heartily welcome you to this city. Those of you who have not visited Los Angeles for some time will doubtless see a great change in the city. We have grown with rapid strides in the past few years, in fact to such an extent that it has been difficult for the public service corporations to keep pace with the city. But we who have watched the city grow and helped to make it what it is, feel proud of what has been accomplished, and we bid you a hearty welcome with the hope that your stay here will be both pleasant and profitable.

During the past year the gas industry on the Pacific Coast has shown a steady and healthy growth which bids fair to continue. Many difficulties have been met and overcome but many problems still confront us. We have endeavored to select the ones of most vital interest as topics to be dealt with in detail by the papers to be read, but there are a few matters which I wish to briefly review for your consideration. For better presentation I have divided these matters into the general subjects of "Manufacture," "Distribution," "Legislation," "Labor Conditions," and "Miscellaneous."

W. B. CLINE
President Pacific Coast Gas Association

Manufacture.

The development of extensive oil fields and the lack of any large coal beds, have made the question of producing gas from oil one of absorbing interest to gas men on this coast. Up to the present time one process of oil gas manufacture, with slight variations, has been generally adopted. This has long since passed the experimental stage and reached the point where we can take up the refinements of plant economy. We have proved our ability to regulate the heat units and candle power and our principal efforts are now bent toward greater oil efficiency and generator capacity. I presume our ultimate aim, although we may not reach it for many years, should be a continuous process and one which would gasify all the oil, thus leaving nothing but gas to be handled by the companies.

Under the present method we are still confronted with the problem of the handling and disposition of carbon or lamp-black. Recently experiments have been made with a filter similar to that commonly used in filtering ore slimes in mines, the idea being to re-

[1] 18th Annual Meeting, Los Angeles California, September 20-23, 1910.

move most of the water from the carbon with this filter as it comes direct from the generators, then to pass the carbon through a mechanical drier, when it would be ready to briquet or use otherwise. If this proves successful it will avoid the necessity of having large drying pits and large cranes or other handling apparatus.

The question of the most economical use of carbon is one which presents itself differently in each individual case. The Los Angeles Gas and Electric Corporation has found it pays best to briquet it and retail it for household use. I believe that in most cases if this fuel is properly placed before the public it will find a ready market at a price that will net the company greater returns than will any other use. It is undoubtedly one of the best solid fuels that can be obtained.

One question which always has our attention and which is probably watched with the keenest interest, is the matter of oil supply. Recent oil developments have been quite successful, especially in the Kern field, one gusher brought in said to be producing more oil than had theretofore been produced by the whole field. Up to the present time, however, the oil companies seem to be the only ones benefited, as they have combined to shut down a number of their wells and are storing large quantities of oil, so that the price has shown little decline.

My attention has been called to a piece of apparatus lately developed, which is causing considerable discussion among electric men, and which may prove useful in the operation of gas works; that is the low pressure turbine. This provides the most economical use thus far discovered for exhaust steam. Turbines are coming into quite general use for driving auxiliary apparatus at both gas and electric stations, and seem to be particularly well adapted to high speed machines.

Distribution.

The system of high pressure distribution, especially distribution through high pressure feeder mains to low pressure laterals by means of street-main governors, is everywhere growing in favor, and its advantages in the way of better pressure control, ease in handling variations of output, and decreased original cost are being generally recognized. This system was first introduced and developed in America, but since it has been demonstrated that compression does not seriously affect the quality of the gas, other countries are fast taking it up.

In this rapidly growing western section of the country, this system seems to have been adopted as the only means of keeping pace with the increasing demand. Where cities and towns are growing and spreading so rapidly and where sections of country which one year are sparsely settled farming districts are the next year thriving villages, it becomes necessary to have some system of distribution which can readily be changed to fit any condition, and this system seems to serve the purpose better than any other yet devised.

It has been found, too, that gas can with economy be distributed at much greater distances from the works than was deemed advisable a short time ago, thus enabling small communities to obtain a supply at a reasonable price where it has heretofore been practically impossible. In the larger cities the companies are extending high pressure lines to supply the suburbs and outlying districts, and the smaller towns are combining with one central works feeding several small cities.

Throughout the east there has been considerable experimenting and discussion over the problem of oiling meters. There was a very interesting paper on this subject read at the last meeting of the Illinois Gas Association. It is possible this matter might be taken up with profit by gas companies on this coast.

Legislation.

There has previously been brought before this Association the question of having a State Public Utilities Board appointed. This is a matter of the utmost importance to all public utility corporations and I would urge you to give it every possible aid. It has been demonstrated time and again that local men are not capable of fixing rates for public service corporations without prejudice. Corporation baiting has become too popular to be resisted by the petty politicians who usually have this matter in hand and the hearings are the most veritable farces. Moreover, under the present method, rates are reduced to ostensibly give what would be a fair rate on a perfectly safe investment, but at the same time we are offered absolutely no protection either from the municipal ownership craze or the devastations of "pirates." Several of the eastern states have already adopted the plan of regulating public service corporations by a State Commission, generally appointed by the Governor and composed of men from various parts of the State, thus putting the matter as far as possible in the hands of disinterested parties, and it seems to be proving a benefit to both the corporations and the community. A competent State Commission I believe would insure us fair rates and a much more settled condition as to competition, etc., thus enhancing the value of our securities.

In connection with rate-fixing, one point which has always been a matter of contention between municipalities and corporations is whether the "going value" shall be considered. By its decision in the case of the City of Omaha vs. the Omaha Water Company, the Supreme Court of the United States has apparently definitely decided that municipanties must consider this in their dealings with corporations. This was a case in which the city desired to purchase the water plant, and in deciding the case the court uses the following language, about which there certainly can be no doubt:

"The option to purchase excluded any value on account of unexpired franchise; but it did not limit the value to the bare bones of the plant, its physical properties, such as its land, its machinery, its water-pipes or settling reservoirs nor to what it would take to reproduce each of its physical features. The value in equity and justice must include whatever is contributed by the fact of the connection of the items making a complete and operating plant. The *difference between a dead plant and a live one is a real value and is independent of any franchise to go on or any mere good will as between such a plant and its customers.*"

Another matter which was brought up at the last session of the California State Legislature, but which was afterward defeated at the polls, is the separation of State and local taxation. I hope this question will again be taken up with more successful results, for I believe a carefully framed amendment to our constitution would accomplish much in the way of a more equitable assessment of public service corporations than is now possible, and would avoid the continual wrangling with equalization boards and expensive lawsuits now necessary in a great many cases to obtain a fair property valuation.

There is still time now to get these matters before the next session of the Legislature and I hope the necessary steps will be taken to have them enacted.

Another care has been added during the past year to the already plentiful supply now worrying the corporation manager. A Federal tax of one per cent per annum has been imposed on the net income of all corporations, above $5000. No corporation will object to a reasonable license tax for the privilege of doing business as a corporation, but as our corporate charters come from the State, this law can be regarded only as a revenue tax, and it certainly seems an unjust discrimination that a corporation should be taxed on its income while individuals of equal wealth, and perhaps carrying on exactly the same business, contribute nothing. This matter is now in the courts and it seems as though it should be decided unconstitutional.

Labor Conditions.

There has been one drawback to an otherwise generally successful and prosperous year, and that is the strikes which have occurred, principally among the metal workers. There seems to be no reason for these strikes except a general discontent and desire to extend the domination of the unions. This is a matter which seriously affects the gas industry, not only because it means delay in construction work needed for the winter's load, work which many times cannot be put off without disastrous results, but also on account of the general hard times it brings to all industry. I hope the iron foundrymen will stand firm in their resistance to the demands of the union, and I believe that we as gas men should render them every assistance in suppressing the agitation. I believe that all employes should be accorded liberal treatment and given every opportunity to learn and advance themselves in their work, but one successful strike merely leads to another and one concession granted to organized labor merely means another demand, until they reach beyond all reason.

Miscellaneous.

The recent perfection of the tungsten electric light has given zest to the competition between electric and gas lighting, and there have been great improvements made in the incandescent gas lamp as well as in the electric light. It must be admitted that up to the present time, in economy and in the quality of the light given, the gas lamp has not been surpassed, and much has also been done in the way of making it as convenient as the electric light—a single chain on a fixture or a push button on the wall now taking the place of the match. The United Gas Improvement Company of Philadelphia has recently fitted up a large store in the heart of the business district, devoted entirely to handling gas appliances. A recent circular of theirs gives illustrations of some very neat and attractive fixtures which equal in every way the most modern electric fixtures. A notable demonstration of what can be done in gas lighting was also given by the National Commercial Gas Association at its exhibition in New York last December.

One thing that has hurt gas lighting considerably in the past has been the claim put forth by many that it was unhealthy, but it has recently been shown by eminent scientists that, especially in large halls, it is rather beneficial than otherwise.

The gas furnace and automatic water heater have recently been brought to a state of perfection which makes them commercial appliances and they are now potent factors in increasing the consumption per meter. There has also recently been placed upon the market a new gas laundry iron which I hope will supply a long felt want in the appliance line. Since ballooning has become such a fad the sales of gas for this purpose is quite a consideration in some places.

Last December a very serious and unusual accident happened in the collapse of a 7,000,000 foot holder in Hamburg, Germany. It is very improbable that such an accident could happen in this country, but it has had its effect upon the gas industry all over the world from the fact that the impression undoubtedly given the general public, who have not time to analyze such matters, is that all holders and all gas works are dangerous. As a matter of fact, however, this accident seems to have been caused by the very extraordinary custom adopted in some cases in Germany, of building annular holder tanks and leaving the space inside to be used for storing materials, etc. The iron roof of this store-room, upon which of course was exerted the pressure due to the weight of the lifts of the holder, was probably defective, allowing the gas to leak out through the chamber below to nearby generator fires.

Speaking of holders, I noticed in a recent issue of the London Journal of Gas Lighting a description of a holder tank with bulging sides. It is claimed for it that the strain is more evenly distributed, allowing much lighter plates to be used and consequently effecting a very material saving in cost. At first glance this seems a very peculiar method of construction, but as the one described, located at Simmering, Vienna, is apparently in successful operation and is of no small proportions, being a 5,300,000 cubic foot holder, it would seem that this question might be looked into with considerable profit.

The matter of rates charged for public utilities has been brought very forcibly to our attention recently by the increase in the prices of other necessities of life, especially the rise in the price of meat. We may well feel proud that rates for gas and electricity, on the contrary, have shown a steady decrease, and I hope that every effort will be made to continue this decrease in the future. The matter of revising rates cannot be gone over too frequently by the companies. In the larger cities where the rates are regulated by

municipal authorities there is little opportunity to charge more than a fair rate, but in the smaller cities where there is no interference of this kind the temptation is to put this matter off longer than is for the best interests of the companies. Such a policy causes hard feeling not only against the particular company but against public service corporations generally.

Before closing I want to take this opportunity to thank the officers for their valuable and untiring assistance during the past year. They have done excellent work for the benefit of the Association and are deserving of much praise.

I also want to call your attention to the Appliance Exhibition at No. 416 West Sixth street. Our Novelty Editor has succeeded in getting up a display which is a credit to the Association and I believe much benefit will be derived from it. I hope you will not fail to visit it.

Some excellent papers have been prepared for the meeting. The subjects chosen I believe will prove of the utmost interest to all of us and they have been ably handled. Our Wrinkle and Experience Editors have also been successful in getting together some very interesting and instructive data in their departments.

The thanks of the Association are certainly due to the four local gas corporations which have provided, in connection with the meeting, such generous entertainment for the members of the Association and their families.

COMBUSTION OF GAS CARBON OR LAMP BLACK.[1]

BY R. L. CLARKE.

One of the most aggravating positions for a gas engineer to be placed in is the accumulation of the by-products for which there is very little market and very little use about the plant. This has been the case for many years past in the manufacture of coal gas in which the by-products of coke, tar and ammonia were necessarily considered in the profits of the plant and derived entirely from the judicious sale of the same. The problems have been worked out by the coal gas companies by the introduction of water gas apparatus to consume the coke, the placing of tar burners under the coal benches and boilers to consume the tar, leaving only the ammonia as a by-product for commercial sale.

With the advent of the oil gas industry which originated on the Pacific Coast, a new by-product came up and is an important factor in the economical manufacture of gas, i. e., carbon recovered from the manufacture of gas from crude oil. The first plants manufacturing gas from crude oil considered this carbon a nuisance and expense, an entirely unwelcome visitor about a clean gas plant, but as the gas manufactured from crude oil increased and a larger number of gas plants adopted the system, it became generally understood that the carbon was at least good for fuel under the steam boiler. Later on its value was increased by being briquetted and sold to the public for fuel. Later this carbon was again increased in value by its use in water gas generators in place of coal or coke and in these generators it delivered a gas superior to the oil or water gas, even increasing the B.t.u. of the mixed oil and water gas. This is at present the height of economy in the use of this gas carbon but all gas plants are not equipped with the necessary water gas apparatus or the necessary carbon coke ovens with which to carry out this system and in fact most of the plants of the Pacific Coast are burning this carbon under their steam boilers at a great loss in efficiency compared with the use of the carbon in a water gas plant. In this connection this paper will be confined to the practical combustion of gas carbon under boilers as found in the ordinary gas plant, and will not enter to any extent, into the technical and chemical points in the combustion of this carbon.

It has been the custom in most gas plants to burn this carbon under boilers of the ordinary form on cast iron grates or on improved forms of wrought iron grate bars and also on water cooled grate bars. All of these methods either with natural or forced draught, have been tried out and have resulted in the destruction of the grate bars in a short time by the excessive heat. Each plant has its own individual plan of grate bars and system by which the carbon should be burned under the boilers. It is varied from the simple throwing in of the carbon on the grates, to an exacting method of coking the carbon on the front of the grates and then distributing over the surface of the grate bars, after the carbon becomes incandescent. There has also been some economy gained by the introduction of an oil or tar burner above this layer of carbon burning on the grates. This method of burning carbon is absolutely wrong and in opposition to all the correct principals of combustion. It is impossible to bring a fire up to the point of incandescence and then by throwing on top of it a blanket of wet carbon, expect to get proper combustion or efficiency from the fuel consumed. It is radically wrong, even to the extent in which it is carried out in a water gas plant, where the carbon is burned down by several runs of the generator to place several feet of wet carbon on top of an incandescent fire. It is like handing the company a gold brick.

With this opinion in view, I have tried to design a furnace in which the principals of combustion of not alone gas carbon but coal and coke, can be carried out with more economical results. In the case of coal and coke the resultant ash and clinkers are a factor to be considered, which in the furnace I refer to has not been considered, as the presence of ash and clinker in gas carbon is so small that this point can be overlooked to a great extent.

The first attempts to properly burn the gas carbon were made by the use of one of the under-feed stokers, commonly used in connection with the burning of coal. The results obtained were so encouraging that it led to further experiments and resulted in the designing of a gas carbon furnace similar to a dutch oven. The ordinary efficiency obtained from the burning of gas carbon on grates, either with forced or natural draught, was not over two pounds of water evaporated per pound of carbon and the boilers could

[1] Paper read at 18th Annual Convention Pacific Coast Gas Association.

not possibly be worked up to their capacity with this system of burning the carbon. By the use of the under-feed stoker, the efficiency was increased to four pounds of water evaporated per pound of carbon and the boilers were worked up to their capacity without the least trouble.

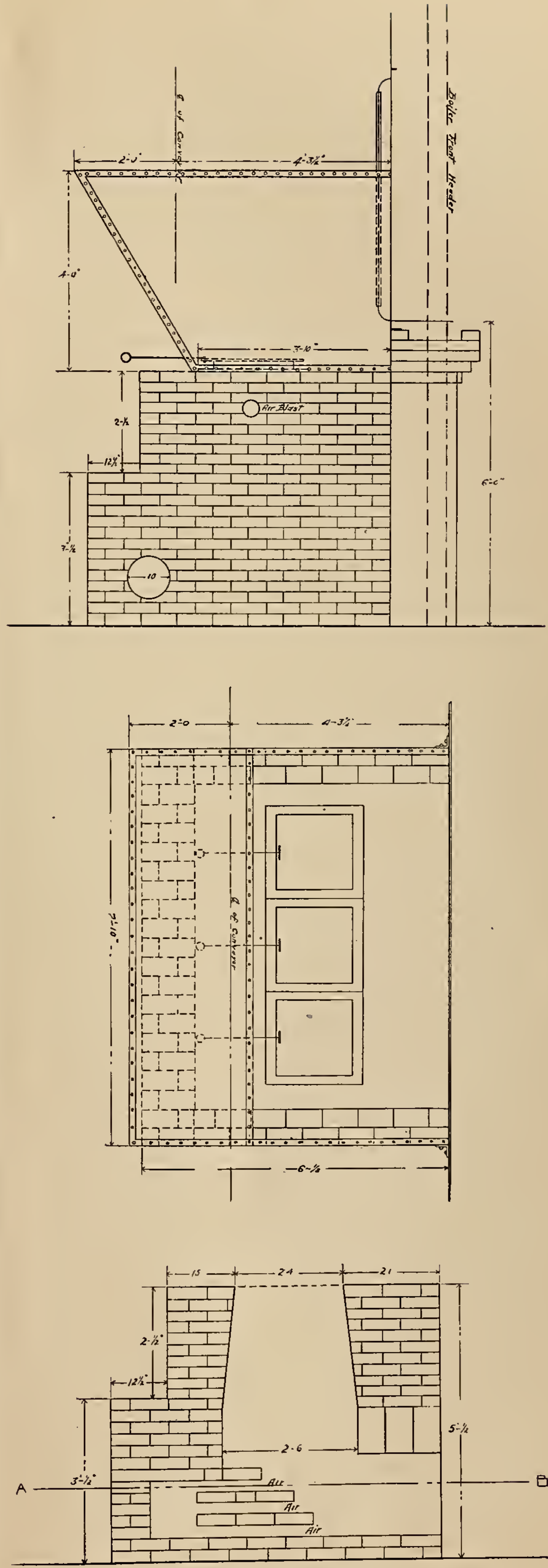
Encouraged by this result, a furnace was designed and erected similar to a dutch oven, such as is used by a great many in the burning of saw-dust, only the operation of the furnace is reversed.

By reference to the illustration it will be noticed that this furnace is designed on the lines of a base burner coal stove. The main apartment of the furnace containing the carbon, is rectangular and cone shape, being several inches wider at the bottom than at the top where the doors for the admission of the carbon are placed. This is designed to facilitate the

Gas Carbon Furnace

feeding of the carbon which is burned away at the bottom of the furnace. Experience with this furnace has shown that if the walls are perpendicular, the carbon will "hang up" and not feed down unless some mechanical means is used to force the carbon down on to the air blast. Next to this apartment of the furnace is located a blast flue into the end of which is connected a blast pipe delivering air at the pressure of 8 in. of water from an ordinary blower.

The wall dividing this air flue from the main apartment of the furnace in which the carbon is being burned, is checkered with air flues so that the air is driven into the carbon at the base of the main apartment and after passing through the body of carbon and combining with it, the resultant flame passes under an arch into the boiler setting at a point which would ordinarily be the ash pit. The heat of the flame when passing through this archway into the boiler setting is intense and the combustion is complete, all



—SECTION THRU C-D—

Details of Gas Carbon Burner.

smoke being eliminated and after a few hour's run, the brick work of the furnace of the boiler acquires an almost white heat and it has been necessary to caution the firemen as to the limit of heat that can be maintained on this arch, the walls of the boiler setting and the tubes of the boiler. If care is not taken in regulating the blast on this furnace, the arch will be melted, necessitating the rebuilding of the furnace. An air blast is also introduced just below the filling doors of this furnace for the double purpose of forcing the smoke and gases, that are formed in the top of this apartment, down into the incandescent carbon at the bottom and also to gradually dry out and remove the moisture from the carbon and force it down through the fire. Air ducts are also placed through the top of the arch for the dual purpose of cooling the arch and aiding in the combustion of the gases, which are passing the arch, similar to the system used in an ordinary regenerative coal gas bench.

By reference to the prints, it will be seen that the air ducts in the dividing wall between the carbon apartment and the main air duct, are extended by the use of fire brick, so that the lower air ducts are about half way across the width of the main apartment. This is necessary because of the increased width of the bed of carbon at the base of the furnace, the idea being to give an equal depth of carbon in front of each series of air ducts. The combustion in the base of this furnace is intense. There are no grates used in the furnace, it is constructed entirely of fire brick and unless careful attention is given to it, by the firemen, the brick forming the walls and the arch of the furnace will be melted. On account of the accumulation of the slight amount of ash and clinkers, it is necessary about once in ten days to burn down the carbon in the furnace and clear out the accumulation of clinkers and melted brick.

Careful tests made on the boilers to which these furnaces were applied, have given evaporative value to this carbon of five pounds of water per pound of carbon. This carbon contained 40 per cent of moisture when introduced into the furnace. It has been found necessary to have from 30 per cent to 40 per cent of moisture in the carbon to obtain the best results and also to add to the life of the furnace. If carbon with a less per cent of moisture is used, the same amount of heat is not obtained and the fire burns well back into the furnace apartment and melts the openings of the air ducts. This seems to prove conclusively that each particle of carbon with its absorbed moisture is really a small water gas plant in itself. The splitting of the water into its resultant gases and their combination with the carbon, form a water gas that, unless handled with caution, will melt anything that it comes in contact with. By the use of these furnaces, together with storage hoppers above them and proper handling of the carbon by the latest improved mechanical appliances, the dread that every gas man has for the pile of carbon, should soon be eliminated and the profits of the gas companies increased in accordance with the increased efficiency of these furnaces over the ordinary method of burning this carbon.

RELATIONS WITH THE PUBLIC.[1]

BY S. M. KENNEDY.

It is only of comparatively recent occurrence that the majority of public utility companies have given any attention to the subject of relations with the public, and I am compelled to admit that if the importance of the subject had been recognized at an earlier date than it was, there would now be less absolute necessity of giving it the grave consideration it apparently deserves.

A few short years ago a gathering like the present would have deliberated almost entirely on such subjects as "The Merits of Oil Versus Coal for Gas Making," "High Pressure Versus Low Pressure Distribution," "Storage Capacity," "Service Connections," and "Meter Tests"—thinking that with these conditions satisfactory, good service would be assured. Today we recognize that good service only begins with the proper production of the commodity. A few short years ago, all the brains and ability of a company were centered in engineers and operators who could calculate how many thousand cubic feet of gas could be made from a ton of coal, or a barrel of oil, and who, at the end of a year, could explain how their calculations were so much more satisfactory than the operating facts developed. At that time the public was not given the attention it receives today. Cheap clerks and green boys could sell, bill and collect for something which everybody wanted and which could be procured from only one source in a community.

Notwithstanding the deliberations and discussions of the engineers, the service was not always perfect, and history states, complaints were frequently made, but not as frequently given the needed attention. But, note the change today. The presidents and directors of public utility companies are very much on the alert, and anxious to secure men who are able to meet and deal with customers in a manner that will give the customers satisfaction and reflect credit on the company. It has been said that the commercial engineer who can develop the business, and please the public, is much harder to obtain than the engineer who can run a plant or lay out a distributing system.

No one can deny that prejudice against corporations exists in the minds of many people throughout the country. Let us try to analyze how much of this prejudice has reasonable cause for existence, and how much of it may be classed as traditional. To a certain extent, the antipathy of part of the public is founded on hearsay, and not always supported by facts. It has been said "The evil that men do lives after them," and I have in mind the name of one man who put a stigma on public utility corporations which seems to hurt their standing in the public mind as much today as it did a quarter of a century ago, when the crime was committed. He was a gruff man, with a big head, cold looking eyes and a frowning face, devoid of one trace of magnetism. He was a conspicuous figure in the financial world, and the president of a great railroad corporation. I do not recall the circumstances surrounding the unfortunate utterance; I do not know whether or not he had any justification for using the words, but he is credited with having

[1] Paper read at 18th Annual Meeting Pacific Coast Gas Association.

coined the expression "The public be damned." The public loudly resented it then, and the public has since been unmistakably suspicious of corporations, and is ever ready to pounce on corporation words or actions which may have a "public be damned" look about them. Should the public be inclined to forget the words, there are those who will not let them do so. The objectionable sentence is the cheap phrase used as a headline in the yellow journal; the startling utterance of the professional agitator; the slogan of the self-appointed reform politician, and the squirming wail of the unreasonable customer.

Not long ago a company with a reputation for progressiveness, made a voluntary cut in its rate, and also put into effect some modifications in service regulations. A certain councilman in the benefited city, in an effort to minimize the value of the concessions, made a public utterance to the effect that the Great Northern Gas Company had changed from a "public be damned" corporation, to a charitable institution. Experience shows, however, that the majority of councilmen have much more amiable dispositions than the one to which I have referred.

You and I have had to work hard to combat the difficulties forced upon us by the wrongs committed, and the legacies left by others who were in the business before us. But, gentlemen, how often has the decent newspaper had to acknowledge that a company did not do the right thing when it had a chance! How often has the fair-minded business men blushed when he tried to defend the action of some corporation! How often has the cheap politician had good cause for his tirade against monopolies, and how often has the complaint of the reasonable man been met with scornful indifference! These conditions have existed in the past—yes, and maybe they too frequently exist today.

Prejudice against corporations is not likely to be entirely removed, because some varieties of the human family can never be satisfied. However, it is undoubtedly true that this antipathy can be greatly lessened by careful conduct on the part of the corporations, and the timely education of the public as to the real facts surrounding the production and sale of the utilities handled. All reasonable people are willing that a company that gives good service should receive fair profits. However, in a reasonable manner they must be shown just what rates are fair for the service given.

The one thing which is so frequently overlooked in connection with the gas business is that it is an intangible commodity. The purchaser does not see what he is buying, as is the case with ordinary merchandise. He cannot tell by his bill that he is paying only for what he receives. His senses, which are useful in buying other things, do not help him with his gas purchases. The only sense which sometimes comes into use is that of smell, and if he were to rely on that, he would often think he were getting ten times as much as his bill called for. Now, under conditions like these, we must rely on something to take the place of the senses, and the only substitute is represented by the word confidence. It will be through our relations with the public that this confidence will be established on firm ground, or wrecked in the quicksands of indifference.

Let us now consider what are the principal means or opportunities which we have for friendly relations with the public. It seems to me that they are four in number: (1) the press, (2) personal interviews, (3) letter writing and (4) the telephone.

The public utility corporation needs the columns of fair newspapers to help in educating its customers and the public generally as to the best uses of the commodity handled, and to counteract the effects of inaccurate and sometimes intentionally misleading information, which emanates from misinformed, unreliable or prejudiced sources, and which in the absence of other information is accepted as correct. Good advertising is as useful to the gas company as it is to the department store. If you feel that your customers are not using as many thousand cubic feet as they should, show them by newspaper advertising how they can with advantage to themselves use more. If the public has wrong ideas as to your business and its operation, use the reasonably disposed newspapers to put them right. You have no more important duty to your own interests than that of educating the public to a proper appreciation of existing facts, after you are sure they are what they ought to be. All publicity of misinformation should be counteracted by even greater publicity of the true conditions. The public talks of your enormous income; tell them about enormous expenses. Much is said about your tremendous profits; tell them about the great repair and maintenance bills you are called upon to pay; tell them about the depreciation bill which is running up against you day and night; and tell them about the small rate of interest earned on the capital invested.

Tell the public what you are really doing for them. Show them how constant and ready is your service. The consumer turns a valve in any part of his house; instantly the service is at his command. Does the grocer, butcher or baker serve him as quickly? Are the street car, or the telephone, or the telegraph companies at his command as readily? Let them know these and other advantages they possess through your agency. Tell of your difficulties, your successes and your plans for the future. Do not permit the impression to be created, through carelessness or lack of frankness, that the aim of the company is to take money irrespective of public obligations. You will have to be candid. You will require to be frank with them before you will have their confidence.

On the other hand, a lack of a reasonable measure of publicity is likely to be regarded as evidence of conditions which you desire to conceal for fear the knowledge of which would tend to create an unfavorable impression.

Let us now consider the subject of personal interviews. Yours may be a great company; abundant capital and many influential stockholders. Your president and directors may be excellent men, with high standing in the community, but the truth is they are probably known to only a few of your customers. Now, the public does not judge a company by its officers and directors, but by such employes as clerks, collectors, solicitors, meter readers, troublemen and others with whom business brings them into contact. These are the men who see the customers in your office, or meet them in their homes or places of

business, who represent the company in its intercourse with the public, and it is by the words and actions of such men that the public praises or condemns your company. Each man connected with your organization can do something each day to help your company's standing in the public mind. But one man's lapse into careless inattention, or lack of tact may undo in a minute all the good which you may have built up to your credit in a month. Clerks in the office, and employes working on the outside, do not fully realize their importance in connection with the success of the company's business. Sometimes those a little higher up than the employes mentioned, overestimate their importance, and do as much harm as those below them. An authority on the subject recently stated that "at least seventy-five per cent of public ill feeling against public service organizations has been failure of operating companies to take pains to please their customers." If such is the case, consider how important it is that each man should be informed as to what depends upon him, and have him realize that by his words and works the company is being judged.

You may issue instructions time and again as to the deportment of your men. You may print books of rules and regulations and distribute them throughout your different departments, but unaided they won't obtain the desired results. Your men must also be taken into your confidence. The heads of departments must know the company's policy and wishes, and must impart them personally to the men under them, and again and again, at every opportunity, by word and action, show how the public must be treated.

It is a fact much to be regretted, that as a rule there is not the right sympathy between the public and the gas company. Why does this condition exist? Is it because they do not understand each other? Well, why don't they? Because the company is largely at fault! True, the intention of your directorate may be perfect, but a certain undesirable place is reported to be paved with those things. Intentions must be followed by instructions, and instructions must be carried out by individual employes. It may be true that your business is the only one of its kind in your community, and that the public must come to you if it wants service. Did you ever stop long enough to consider that that very reason does not make the public less critical? If your customers are treated with consideration, it is particularly pleasing to them, but if with discourtesy, it rankles through and through, because they have no recourse, but must continue doing business with you. Customers will ask questions about what they do not know. Employes may be asked the same question fifty times a day, by fifty different people. But what of it! They all want the information, and if answered politely, will usually be satisfied. Each man representing a point of contact, who meets the public personally, should be selected and fitted for his position. At your plant you use great care in the construction of your machinery. You would not think of putting a half inch rivet into a one-inch hole and expect it to work satisfactorily. You would not permit a rough surface to remain on a valve which you must handle constantly. Well, keep your eye on your office and use the same amount of sense. Don't expect an inexperienced boy to handle your complaints satisfactorily. Get more mature men. They will handle the public better, and the public likes to talk to them. Look out for the men with the rough surfaces; the men who prefer to argue and not explain. They may win many arguments, but they lose many friends for your company. While your mind is on your office force, take a look at the office itself. That high railing and grill work is not necessary, and obstructs the view. Take it down. Those little windows through which your clerks talk have a stand-off appearance; abolish them. Let the public see into your office and learn what your men look like. Let your men have a chance to mentally put themselves in the customers' place. Perhaps it will help them to understand each other better.

Letter writing is of great importance in connection with the relations of the larger companies with their customers. Many complaints are forwarded in letters; many inquiries are received, and requests made. We all know that a letter itself is only cold type and thin paper. The gesture, the facial expression, the twinkle of the eye and the nod of the head, are all absent. Just the words are there to do the talking. Consequently we must be more than careful. After what we have dictated has been forgotten, the letter remains in the other fellow's possession, and he may take it up, now and again, to look at it. If it contained anything that hurt when received, it probably hurts more each time it is read, and likely the reader is loading a gun for some one. A hot letter sent in reply to a caustic letter received, is poor business. Your letter may be really smart and burn with righteous indignation, but what good does it do your company. Suppose your customer had some grievance, real or imaginary, he had better be conciliated. If not, he will become more angry, and talk against you, and take his business somewhere else at first opportunity. Your company's letters to customers should be handled by experienced employes.

Have you ever recognized how much of your particular business is handled over the telephone, and with what rapidity the number of telephone calls increase? This point of contact bids fair to one day become the most important of all. Perhaps even today the telephone is the door through which most of your patrons enter. Better be sure it is well oiled and well attended. You probably have a private exchange. Does your operator answer pleasantly with the company name, and connect at once with the person and department wanted? Do you know that when the department answers, as well as when the operator answers, the response is clear and courteous. Some one responsible in your office should see that employes handle all telephone calls with the same degree of care as they do when attending to patrons who make personal calls at your office. The telephone is a great factor in your business, and should be developed with the care and attention its importance merits. Insist on telephone calls being answered promptly and pleasantly. Experience has shown that over the telephone as nowhere else, pleasant tones and courteous language are required. One must make his impression entirely through what he says and the

way he says it. The telephone of some companies is frequently a liability, but it can and should always be made a valuable asset.

In all of a public utility company's relations with the public, the attribute of tactful courtesy should be paramount. This quality attracts the new customers you are looking for, and makes the older ones feel at ease and satisfied. It is in fact the open sesame to the public good will. It must now be acknowledged that a company cannot long be successfully operated without the good will of the public. No company can afford to assume an independent attitude. No matter how big the corporation, it is vulnerable; its very greatness sometimes making it a bigger and a better target. And as for independence, the man who runs a peanut cart, and has only a five-dollar capital invested in his business, is a thousand times more independent than the corporation, with its millions. This good will we want does not come by saying one thing and doing another; it comes by doing the right thing—the square thing, all the time; by giving care to what is promised, and by keeping the promises made.

This real courtesy we are talking about does not mean palaver, bowing and scraping, but common, ordinary, every-day politeness. It does not mean toadying to customers, whether they are big or little, but the giving to all a cheerful attention. It is the kind that gives and wins a smile; the kind that does not forget to say "thank you" when the opportunity occurs. This sort of courtesy is a fine art, and is as necessary to the healthy growth of your business as is the sunshine to the flowers.

The larger a corporation becomes, the greater the tendency to drift farther and farther away from individual consumers. Instead of speaking of "our customers," we speak and think of the public. Now, that is just the condition that our customers do not like. They object to being herded, and desire their individuality to be recognized. The representatives of a corporation in any city should be men who are identified with the city's interests in public matters; should be connected with civic and commercial bodies, and known to be working for the up-building of the municipality. A line up with commercial clubs, boards of trade, and similar broad-gauge civic bodies, will eventually be more profitable than patronizing politicians, and wasting time in attempting to manipulate political machinery.

Let us encourage our men to know and remember our customers by name. They are human and like it. Of course, each man cannot remember all of the company's customers, but each man does not come in contact with all. It is those he constantly meets that the employe should be expected to know. One of the best ways to know a customer is when he comes with a complaint. If a man has a complaint rankling in his breast, the only thing to do is to get it out. Troubles and complaints are opportunities to make friends; and friends made this way are good workers for you and your business.

Much is said these days regarding the "public policy" of companies such as are represented here, and almost every gas and electric association in the United States has a standing committee that brings in regular reports on the subject. Now, there are two definitions to this word policy, (1) A system or method for the administration of the affairs of a government or of any institution; (2) Management or administration based on temporal or material interest, rather than on principles of equity—hence, worldly wisdom, cunning, stratagem. It will be remembered that I am not now speaking for any company or organization, but for myself alone. Consequently, I am free to state that there are times when I have seen or heard of the word policy being used in the latter sense that I have been tempted to exclaim "policy be damned." Away back some years ago, when I was learning to write, I spent hours copying a headline which read "Honesty is the best policy." I have learned since those days that it is a good thing to be honest, and if one has no other reason for his honesty, let him be so as a policy. But all the same, it is a mighty poor reason.

Maybe we consider policy too much in our relations with the public. When I borrow my neighbor's lawn mower, and he gets the loan of my wheel-barrow, we don't think of the question of policy. We are neighborly, and that's all there is to it. When I want to buy a cigar, or a necktie, or a pair of shoes, I don't consider the question of policy—I just drop in to some store I know, and select what I want. I probably know that the man keeps the desirable kind of goods; that his prices are right; and that he and his assistants are courteous, and have a smile or a word of recognition when they see me. In personal matters, I may sometime think of reciprocity, but not of policy. Our customers should realize that, after all, a corporation is only an aggregation of individuals. I recognize that some things must be done for politic reasons, but why should a corporation eternally require to study policy? Why not the man to man idea, instead of "the corporation and the public" attitude? Why not have customers go to your office to do business feeling that they like to do business with you? Why not cut out the word policy in the sense it is usually accepted by corporations, and let your patrons understand that the only policy you know in connection with your company is "the public be pleased." That policy does not mean giving way to all demands. It does not necessitate loss of dignity, self-respect, or income, but, on the contrary, when faithfully carried out, it represents the easy, safe and profitable way of doing business. With a "public be pleased" policy, your difficulties will decrease in proportion with the length of time it is in effect, and the subject of "relations with the public" will gradually be changed from a vexed problem to a condition closely resembling that of pleasure.

The largest induction coil, hitherto the famous Spottiswoode, is now stated to be a German coil which gives a 50 in. spark, requiring 30 amperes at 110 volts. The iron core is 80 in. long. The primary coil consists of six layers of copper tape, making altogether 792 turns, and the secondary coil contains 100 miles of copper wire about one-hundredth of an inch in thickness.

A SYSTEM OF RATES FOR ELECTRIC LIGHT AND POWER AND ITS APPLICATION.[1]

BY STEPHEN A. HOAG.

Electricity is a manufactured product and, like other manufactured products, the cost at which it is sold should be proportional to the cost at which it can be produced.

If electricity could be manufactured continuously at a uniform rate and then stored away to be supplied when required, it could, like many other manufactured products, be sold at a uniform price. But electricity cannot, like oil, be drawn from a barrel when wanted. nor like gas, taken from a holder where it is stored; manufactured goods can be made and placed in warehouses to be supplied when there is a market for them, water can be pumped steadily from wells to reservoir where it is held subject to the demands of the consumers, but electricity must be manufactured the instant it is used; the generators must turn and the network of distribution lines must be kept hot, holding in reserve current subject to the instant call of every customer on the line. Now, if the requirements of these customers came at various odd times during the day they might be made to fit in and overlap one another and produce some sort of uniform load, but unfortunately this is not the case, for their demands occur simultaneously as darkness comes upon us all at the same time and artificial light is needed to prolong the daylight hours. This means that an electric generating station must have an excess of capacity over that ordinarily required simply to supply current during one or two hours of the working day, moreover, as darkness comes an hour or two before the close of the working day in winter, while it comes after the close of the working day in summer, it follows that the demand upon the electrical generating station in the winter will be much in excess of the demand during any other season of the year.

To arrive at a proper rate of charge for electrical energy it is first necessary to determine the nature of the costs which enter into its production and then to properly proportion these costs among the various customers served so each shall bear his just share and automatically earn the rate which he gets.

For every electric light plant with its distributing system, there are certain overhead expenses which are independent of the output or kilowatt hours generated. These are the fixed expenses of interest and depreciation, taxes, insurance; also salaries of officers, general office expense, advertising, legal fees, etc. All these expenses go on day by day whether current is sold or not. Then there are the variable expenses of operation which are directly proportional to the output. Among these is included fuel, if the plant is operated by steam, also oil, waste and miscellaneous supplies, wages of various operators, maintenance of machinery, cost of operating lamps and meters, incandescent lamp renewals, etc.

From the fact that, as we have seen, a plant of large excess capacity is required to take care of the heavy lighting demand of the winter peak, it is evident that the fixed charges on this large investment will constitute a large part of the total cost of producing current, also that the more hours this plant is operated each day, and the greater the number of kilowatt hours produced, the lower will be the unit cost per kilowatt hour, since the fixed expense remains constant while the running expense varies with the output.

To illustrate in figures: Consider the case of a plant of 400 kw. rated capacity costing $100,000 ($250 per kw.), for generating and distributing system complete; assume the fixed expenses not proportional to output as 16 per cent of total cost ($16,000 per year). Assume variable expenses at 2 cents per kw.-hour. Then if this plant were to run 24 hours per day for 365 days of the year (load factor of 100 per cent), it would generate 3,504,000 kw.-hours and the fixed expenses of $16,000 divided by 3,504,000 gives a fixed charge of .456 cents per kw.-hour, which, added to the variable charge of 2 cents, gives a total cost of 2.456 cents per kw.-hour for current produced. If, however, this plant operated only one hour per day (load factor of 4.17 per cent) instead of 24 it would generate 146,000 kw.-hours and $16,000 divided by 146,000 gives a fixed charge of 10.958 cents per kw.-hour, and adding 2 cents to this gives 12.958 cents total cost per kw.-hour generated. The following table shows the variation of the total cost of current with different number of hours' operation of plant per day, or what is the same thing, different load factors:

Average daily hours use.	kw-hour output.	Load factor.	Fixed Exp. per kw-hour output. Cts.	Variable expenses. Cts.	Total Cts. per kw-hour
¼ hour	36,500	1.04	43.84	2	45.84
½ "	73,000	2.08	21.92	2	23.92
1 "	146,000	4.17	10.96	2	12.96
2 "	292,000	8.34	5.48	2	7.48
3 "	438,000	12.50	3.64	2	5.64
5 "	730,000	20.80	2.19	2	4.19
8 "	1,168,000	33.33	1.369	2	3.37
10 "	1,460,000	41.66	1.09	2	3.09
16 "	2,336,000	66.66	.685	2	2.68
24 "	3,504,000	100.00	.456	2	2.45

Now the load factors of its customers combine to make the load factor of the central station, also we are agreed that current should be sold at a price which is proportional to the cost of its production. It follows that a correct rate system must take into account the load factors of consumers and must be so designed that as the consumer increases the number of hours per day that he uses his load, he will automatically get a lower average rate.

This result is accomplished in the so-called "readiness to serve" and "maximum demand" rate systems. In the "readiness to serve" system each consumer is subjected to a fixed charge per month or per year for current held in reserve for him, said charge being proportional to the number of lamps which he has installed and their resulting maximum demand upon the generating systems; the consumer then pays an additional low uniform rate per kw.-hour for all current he actually uses. The fixed or readiness to serve charges are intended to cover those fixed or overhead charges on the generating and distributing system of the central station serving him and the additional rate per unit of current used is intended to cover those operating costs proportional to output.

An example of this rate system is the Doherty system used in Denver, Colorado, where a fixed charge per year is made for each 16-candlepower lamp connected, an additional fixed charge per year for the cost of serving each individual customer, plus a uniform

[1]Read at convention N. W. Electric Light and Power Association, Seattle, Aug. 27, 1910.

rate per kw.-hour for all current used. Another example of a "readiness to serve" system is that in St. Louis, Missouri, and Seattle, Washington, where a guaranteed minimum charge per month is made for each 16-candlepower lamp connected and all current used above this minimum is charged for at a uniform rate per kw.-hour. By guaranteeing a larger minimum per lamp per month, the customer may obtain a lower rate per kw.-hour, which is right, since he thereby increases his load factor.

A variation of the above "readiness to serve" system is the "maximum demand" or "differential" rate system consisting of a primary or base rate per kw.-hour and a lower secondary rate. The base rate applies to a certain number of hours' use per month of the maximum current demand which the consumer calls upon the station to supply, and the lower rate applies to all current consumed in excess of this amount. The consumer does not get the benefit of the lower rate until he has used enough current at the higher rate to reimburse the company for the fixed charge on that particular portion of their capacity which is tied up or reserved for him.

That the above "readiness to serve" and "maximum demand" rate systems are very similar is shown by the following example:

In a certain Western city the lighting rate is 15 cents per kw.-hour for the first 30 hours' use per month of the maximum demand and 5 cents per kw.-hour for all current used above this amount: in a neighboring city the lighting rate is $3 per kw. of the maximum demand per month plus 5 cents per kw.-hour for all current used. Now, with a maximum demand of 1 kw., 30 hours' use at 15 cents per kw.-hour equals $4.50; likewise, 30 hours' use at 5 cents per kw.-hour equals $1.50, which added to the $3 readiness to serve charge equals $4.50, consequently these rate systems above a 4 per cent load factor are identical. They show a difference only for those consumers who use their maximum demand less than one hour per day. These consumers get a lower rate under the "differential" system.

Comparing the above two rate systems, the "readiness to serve" system theoretically fills more closely the requirement that electric power should be sold at a price proportional to the cost of production, and if this is strictly observed in making out any specific case of rates it will usually be found that the short hour user has to pay rather a high rate per kw.-hour for his current. While this is correct in theory, in practice it is usually considered advisable to reduce his rate and actually serve him at a loss, increasing the running charges on the other class of customers enough to make up the difference, because the short hour user and small customer form the largest percentage of customers served and their good will is much sought by the central station, for it is through them that franchises are obtained and expression of public opinion voiced by the press. Reducing the rate to the short hour user also tends to prevent the introduction of gas and gasoline lighting, for it is the customer who has the large installation and uses it for only a few minutes each day in the summer months or perhaps only once a week, on Saturday nights, who most bitterly objects to a high minimum charge and, if he is forced to pay it, goes to the gas company. The moral effect on a newcomer of an electric lighted town where one has to search closely for a gas lighted store, has a great advertising value to the electric company and is a credit to its rate system. For the above reasons I would consider the "maximum demand" rate system with a fixed maximum rate per kw.-hour preferable to the "readiness to serve" system.

We have seen that a rate system, to be correct, must (a) take account of load factor. There are two other requisites which it must also have: it must recognize the fact that (b) the large user of current earns a slightly better rate than the small user; (c) the power user earns a better rate than the light user.

Discussing condition (b) it is evident that a large volume of business at a single point of delivery earns a better rate than the same amount of business distributed over a large area, for it is much cheaper to deliver large blocks of power at one location than an equivalent amount of power to a number of small consumers. The cost of handling individual accounts is saved as well as the additional expense for distribution lines, small transformers and meters.

The Doherty rate system recognizes this by applying a uniform service charge to each individual consumer. A more usual method is to provide discounts for large quantities of current used, these discounts increasing with the size of the bill.

Discussing condition (c): power rates should be lower than light rates for two reasons. (1) The variable expenses per kw.-hour are lower due to certain costs which enter into light service but do not enter into power service—among these expenses are lamp renewals, arc and Nernst lamp repairs and trimming, additional expense and attention necessary to maintain good voltage regulation and reduce complaints. (2) The fixed expenses are lower by reason of the higher diversity factor of a power load. Light demands necessarily come on simultaneously as artificial light is used to prolong daylight and follows natural laws. Power demands of various motors, on the other hand, do not tend to come on simultaneously but vary with the individual conditions affecting them and fit in and overlap one another.

Data collected from various central stations having a large power load indicate that the ratio of the actual demand produced on the generating station, to the rated horsepower of the connected load in motors is 1 to 4 or greater. Contrasting this with a ratio of 1 to 1.5, which approximately represents the ratio of the demand on station to connected load in lamps, we see that the power load should not bear as heavy a proportion of the fixed charges as the light load, hence the "readiness to serve" charge or the base rate for power should be less.

In addition to making its power rates lower than its lighting rates, the central station should also make a further reduction for power used "off peak"—that is within certain specified hours of the day, which hours mark the beginning and ending of the station peak load during the different months of the year. These hours should be specified in the contract and their strict observance should be enforced; this can be accomplished by having the company's inspectors or

solicitors "drop in" occasionally on the customer during those hours when he is supposed to be closed down, or it can be profitably accomplished in the case of large power customers by installing graphic-recording wattmeters or ammeters which serve the double purpose of recording the time at which the load goes off and the amount of the maximum demand.

In arriving at this off peak schedule of rates, the fact to be considered is that the running charge should remain constant and the readiness to serve charge should be reduced, for since this power load by agreement cannot overlap the lighting peak, it does not require or tie up any additional equipment in the generating station but uses the same equipment on which the fixed expenses are already being met by the lighting customers. Theoretically, the fixed charges in this case should be only that necessary to take care of the charges on the investment in line and equipment necessary to serve the particular customer; however, it would not be practical to agree to supply power on this basis, as the company would have no protection against the customer shutting down his plant.

As to minimum charges for power rates: where power is sold on the "readiness to serve" basis, the "readiness to serve" charge per kw. of course is the minimum, but where power is sold on a sliding scale or differential rate basis, there should be a minimum charge per horsepower of rating or demand. This charge varies with various companies, running from 50 cents per horsepower per month upwards; however, $1 per horsepower per month is the most common minimum and is, I think, the fairest for all classes of users. It is low enough to encourage the use of small motors of from 3 to 10 horsepower in stores and small factories and it is high enough to ensure the power company a return of $12 per year per horsepower of connected load, which, as we have seen, equals $48 per horsepower or $36 per kw. per year of maximum demand produced at the station.

Maximum Demand of Power Load.

To arrive at the maximum power demand on which to base a minimum charge, a readiness to serve charge or a base rate, is sometimes difficult. For a single small motor, or two or three motors, the basis should be the horsepower rating, but where a factory with numerous motors must be considered or several large motors operating at an unknown load, measurements should be made from time to time and the actual maximum demand of the installation in question determined.

If the revenue from the installation will justify installing a graphic-recording wattmeter, this is desirable, in fact I have in mind several cases where this is done and power is sold at a flat rate per horsepower per year, based on the reading of this meter. The readings on which the customer is billed each month are a given number of peaks of a certain number of minutes' duration as defined in the contract and this maximum demand once recorded holds until the expiration of the contract or until the meter subsequently records a larger maximum. This method of selling large blocks of power leaves no doubt as to the revenue which will be returned per kw. per year.

Maximum Demand of Light Load.

To arrive at the maximum demand of a lighting load the "maxmeter" or "Wright demand meter" is frequently used. This shows the maximum current in amperes which the given load produces and is satisfactory in some cases. It records with comparative accuracy when used with carbon, incandescent and metallic filament lamps, but is inaccurate when used with Nernst lamps and arc lamps, due to the heavy starting current; however, since the tungsten lamp is rapidly replacing other forms of illumination the maxmeter can be used. But the maxmeter is not always necessary; we know that in certain classes of business the maximum demand is the full connected load, we also know from experience and previous measurement that in other classes of business the ratio of the maximum demand to the connected load is definite—two hotels, for example, similar in size and character, should have the same ratio; likewise two similar office buildings in the same locality. It is advisable to collect and tabulate data as to the ratio of maximum demand to connected load for the various classes of business handled by any one power company. This information can then be used in applying rates and estimating monthly bills in the case of new business.

Residence Rates.

Residence lighting follows the same laws as commercial lighting except that the peak occurs somewhat later, which is an advantage. When "readiness to serve" or "maximum demand" rates are applied to residence lighting, the demand taken should be from 33 1/3 to 50 per cent of the connected load, otherwise the rate will be too high. A residence rate should be so designed as to encourage the use of cooking and heating devices, flat irons, vacuum cleaners, and in fact any device used outside the regular lighting hours. To accomplish this it is necessary that the current used by these appliances come in under the secondary rate, hence they should not be figured in on the maximum demand. Some companies make a special heating and cooking flat kw.-hour rate without minimum and require a separate circuit and meter to be installed for this purpose. However, the wisdom of this is doubtful, as the additional expense of wiring is likely to discourage the customer and a separate meter means more work for the operating and accounting departments of the power company and hence additional operating expense. The same result can be accomplished by the differential rate with a properly applied maximum demand. A form of residence rate frequently used in connection with the maximum demand commercial rate is a sliding scale rate independent of connected load; say, for example, 10 cents for the first 20 kw.-hours used per month, 9 cents for the next 20 kw.-hours, 8 cents for the next 20 kw.-hours and 5 cents for all current in excess of 60 kw.-hours per month. This form of rate saves the trouble of keeping a check on the installation of lamps and its low secondary rate encourages the use of current consuming devices. It should certainly receive consideration.

On all residence rates a minimum charge of at least one dollar per month should be made, as the customer's account cannot be profitably handled for less than this.

Rates for Special Uses of Current.

Sign lighting and outline lighting should be encouraged as they help to increase the load factor. A flat rate for this class of business is desirable, the power company to maintain the lamps. This flat rate can be figured on the basis of the secondary meter rate of the rate system, allowing six hours a day use of current or 25 per cent load factor; this reduces to a flat rate per lamp per month and the signs can be turned on and off at certain definite hours by men employed by the company or the signs can be operated from a "sign circuit" controlled from power house or substation.

Certain classes of business not strictly a power load should be taken at power rates. This applies to blue printing machines, moving picture arcs, tailor's irons and laundry irons, and in fact any load which has the characteristics of a power load and is large enough to justify the installation of a separate meter and circuit. Such devices used on a lighting circuit must of course take lighting rates, but in this case their maximum demand may be estimated at one-half its actual amount since the diversity factor of these devices approaches that of a power load.

Rates for charging storage batteries for automobiles, etc., should be those of the off peak schedule above referred to, as this current can easily be used outside of the peak load hours.

The Lamp Question.

In my opinion a power company should furnish free the first installation of 8, 16 and 32-candlepower lamps to its customers and should also furnish free renewals of these lamps when they burn out. In this way they will control the voltage and make of the lamp used and the customer will get the lamp best adapted to the current furnished. As to the proper wattage of lamp to use, I believe that the Gem metallized filament lamp of 2.5 watts per candlepower nominal rating best fills the requirements. These lamps can be renewed free in the 50-watt and 80-watt sizes, and by using them at their bottom voltage, a life is obtained equal to or better than that of the ordinary 3.5-watt carbon lamp, while the current consumption is much less. Since the first cost of these lamps is slightly in excess of the carbon lamp, the renewal cost per 1000 hours will be about the same, while they give a whiter light and produce better satisfaction among customers. Their use will reduce the load on overloaded lines and transformers and improve the regulation, and by reducing the station peak load will leave more current available for new business. At the same time, with a proper rate system such as we have outlined, the revenue to the central station will be but slightly reduced and this will be much more than made up by the taking on of new business, on a maximum demand basis.

The cost of lamp renewals should of course be kept track of along with other operating expenses and the kw.-hour rate designed to provide for this.

The above remarks as to reduction of station peak by the used of high efficiency lamps also applies to tungsten lamps, only to a greater extent, and with the right kind of rates little need be feared from the general use of tungsten lamps. I am of the opinion that central stations should sell tungsten lamps to their customers slightly above cost and not attempt to maintain these lamps or rent them. If they do undertake the maintenance this should be kept entirely as a separate proposition and not affect the rate per kw.-hour.

In conclusion I may say that it is difficult to lay down a general rate system which will be applicable to all conditions and localities. There may be a public service commission which has favored some particular form of rate and there may be a clause in the company's franchise which specifies the maximum rate to charge. However, the principles of a correct rate system and the application of this system to different classes of business may be laid down, and this I have endeavored to do. By a proper system of accounting and a proper division of the costs under the heads of maintenance, operating expenses and general expenses, it should be possible for any one plant to determine very closely those expenses which are independent of and those expenses which vary with the output in kw.-hours.

The segregation of fixed charges and running charges can then be made and by the proper application of a diversity factor, the fixed charges apportioned among the consumers in accordance with their demand. Those expenses which are peculiar to light service and do not occur in power service can also be segregated, and the proper difference then made between the light and the power running charges. In this way there will be obtained definite rates for any one set of conditions.

Renewing carbon lamps whose filaments are not broken is accomplished by German manufacturers by admitting air to the bulb after unsealing the cap and then burning off the deposited carbon. The air is then exhausted, carburetted hydrogen introduced and the lamp connected in an electric circuit. As the filament glows it absorbs carbon until it has resumed its original section, when the lamp is sealed and made ready for use.

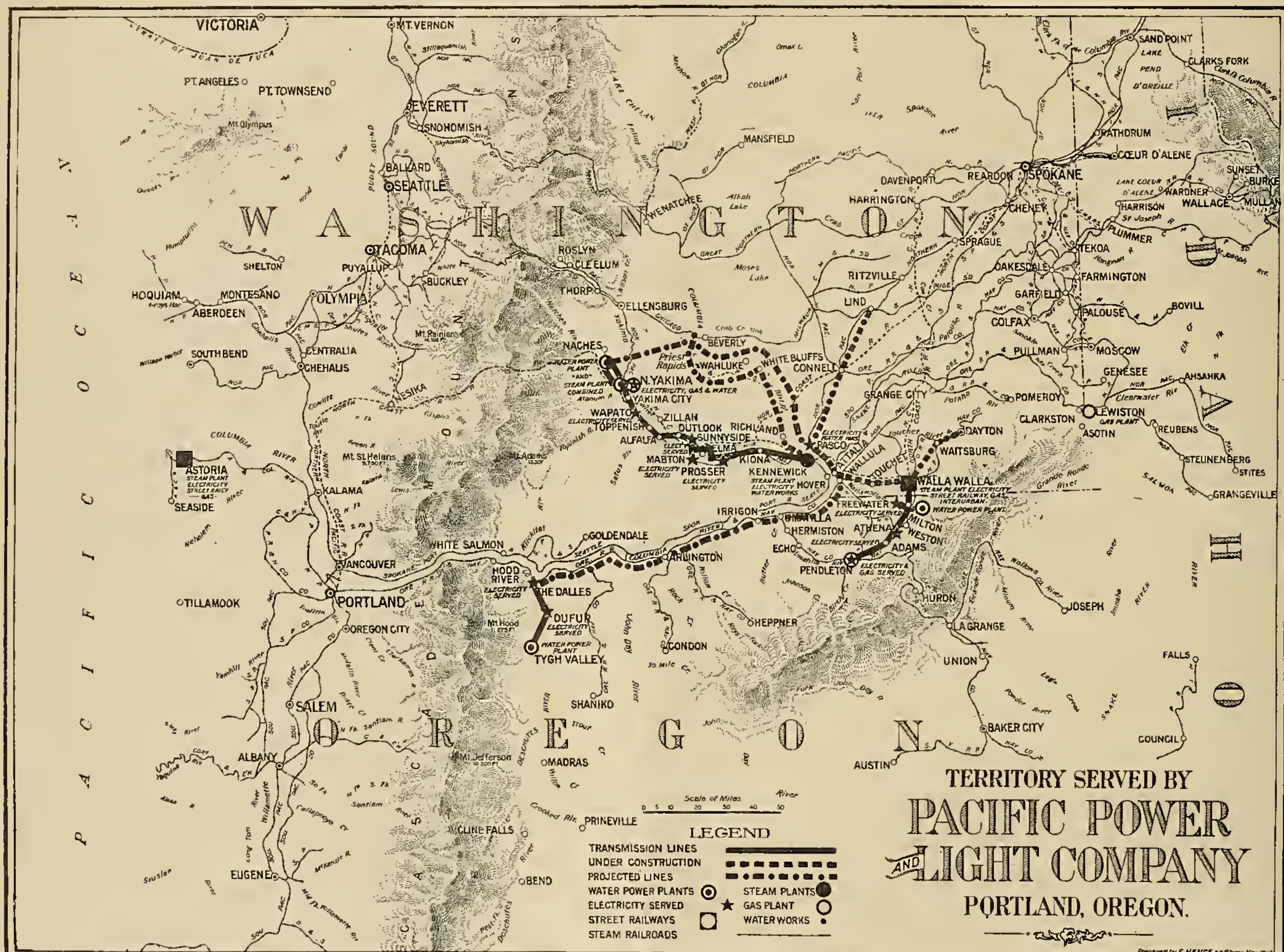
Metallic radium has been isolated by Madame Curie in collaboration with Monsieur de Bierne. The metal is highly oxidizable, and from a clear white soon becomes black. It adheres firmly to iron, decomposes water, burns cellulose, and is rapidly dissipated. This pure element was obtained by electrolysis of the salt, by which means a milligramme of radium amalgam was secured, and on distilling off the mercury at a temperature of about 700 degrees C., the pure metal was left behind.

Mussels in the condenser circulating system have seriously interfered with the operation of a number of English electrical plants. The spawn passes through all strainers and find the iron suction pipe in sea water an excellent home. They soon grow to a large size so that the effective bore of one 30-in. pipe was reduced to less than 16 in., greatly restricting the flow of water to the condensers and putting an overload on the pumps and motors in order to circulate sufficient cold sea water to condense the steam and maintain the vacuum necessary for efficient turbine operation. All suggestions such as boiling, poisoning or electrocuting the molluscs had proven impracticable, and as scraping is impossible, it will probably be necessary to lay a new pipe system above water level with convenient man-holes.

PACIFIC POWER AND LIGHT COMPANY.

With the recent changing of hands of a number of Northwestern power plants which has resulted in the organization of the Pacific Power & Light Company, incorporated in Maine with a capital stock of $7,500,000, the new company has assumed active operation of about a dozen gas and electric plants, including the Astoria Electric Company, operating gas, electric and street railway plants at Astoria, Oregon. Wasco Warehouse Milling Company operating electric distributing systems at Dufur and The Dalles, Oregon, water power station at Tygh Valley, Oregon, and 35 miles of 22,500 volt transmission line. Northwestern company also owned the water works at Kennewick and Pasco, Washington, and an electric steam generating station at Kennewick.

The new company has in operation about 185 miles of high tension transmission line, all three-phase, 60 cycle. It is now building 50 miles of 66,000 volt transmission line between Pasco and Walla Walla, Washington, the completion of which is expected within a month. Work is also progressing on the rebuilding of the North Yakima Gas Works, Walla Walla electric sub-station and the Tygh Valley generating station. This work will cost several hundred thousand dollars.



Corporation, operating fifty miles of 22,500 volt transmission line between Walla Walla, Washington, and Pendleton, Oregon, hydroelectric station on the Walla Walla River, distributing systems at Pendleton and Freewater, Oregon, and Walla Walla, Washington; gas plants at Pendleton, Oregon; Lewiston, Idaho; Walla Walla and North Yakima, Washington. Northwest Light & Water Company operating hydroelectric plant on the Naches River with electric distributing system at North Yakima, Washington, and water works at North Yakima. Yakima Valley Power Company operating 100 miles of 66,000 volt transmission line between North Yakima, Wapato, Sunnyside, Kennewick, Mabton, Kiona and Pasco, Washington. This

Announcement was recently made in Portland that the company would soon build 60 miles of 100,000 volt transmission line between Pasco and Lind, Washington, where connection will be made with The Washington Water Power Company's lines. This work will be done this fall and it is understood that other extensions are contemplated so that irrigators throughout the Columbia and Yakima valleys will have plenty of power for pumping during the next season.

The officers of Pacific Power & Light Company are: President, Guy W. Talbot; vice presidents, Edw. Cookingham, F. G. Sykes; secretary and assistant treasurer, Geo. F. Nevins; treasurer, E. P. Summerson; assistant secretary and assistant treasurer, Lewis

A. McArthur. The operating officials are as follows: General manager, A. S. Grenier; chief engineer, D. F. McGee; general superintendent, Geo. C. Arrowsmith; new business manager, J. E. Davidson. The New York offices are at 71 Broadway, New York City. The Portland offices are at 1211 Spalding Building, Portland, Oregon.

Pacific Power & Light Company is controlled through stock ownership by the American Power & Light Company of New York. American Power & Light Company is controlled by interests affiliated with Electric Bond & Share Company of New York. American Power & Light Company also owns the Kansas Gas & Electric Company of Wichita, Kansas, and Portland Gas & Coke Company of Portland, Oregon, and recently announced that American Power & Light Company had also purchased the controlling interest in the Hanford Irrigating and Power Company, which owns an electric generating station at Priest Rapids, Washington, and about 30,000 acres of irrigable land in the Columbia Valley.

The Pacific Power & Light Company owns the Walla Walla Valley Railway Company, which is operated independently from the electric business. The general manager of the railway company is C. S. Walters and the traffic manager E. G. Miller, both of Walla Walla, Washington.

President S. Z. Mitchell of the Electric Bond & Share Company and about thirty prominent Eastern bankers, recently made a trip through Oregon and Washington, inspecting the property of the Pacific Power & Light Company and the Portland Gas & Coke Company. Mr. Mitchell announced that arrangements would be made for the expenditure of several millions of dollars for improvements on the properties of these two companies during the next few years. Efforts will be made to popularize the use of electricity for irrigating purposes throughout central Washington as the Easterners believe a large field is open for that purpose.

PRIZE FOR SCIENTIFIC ESSAY.

The Association of Electrical Engineers, graduates from the Montefiore Electro-Technical Institute, has recently issued a prospectus of the conditions governing competition for a prize to be awarded during 1911.

This prize, consisting of the accumulated interest on 150,000 francs ($28,950), in Belgian 3 per cent bonds, is to be awarded to the author of the best original work presented on the scientific advancement, and on the progress of electricity in its technical applications. Articles may be written either in French or English, and printed or in typewritten manuscript.

The jury will be ten electrical engineers, five Belgians and five other nationality, under the presidency of the director of the Montefiore Institute. Twelve copies of each contribution must be sent postpaid to M. le Secretaire-Achiviste de la Fondation Georges Montefiore, Rue St. Gilles, 31, Liege, Belgium, before March 31, 1911.

WHERE ANTONE LOST OUT.

BY ANTONE'S BROTHER.

The little tale we will herein relate happened a little less than a million miles from the city and county of San Francisco, and will, I trust, elucidate the fact, as Brother Antone found out to his sorrow, that the great and the near-great, especially the great, are frequently too small to acknowledge their error; thinking that by doing so they keep the fact of their mistakes from the knowledge of their superiors or employers, and endeavor to impress them with the fact that they never make a mistake.

Now, when Antone started out in the business he did not know that it paid not to know some things that the consulting engineer of the company did not know, and he started out to get the best results for his employer, the company.

He happened to work his way up until he was placed in charge of considerable electrical apparatus and as the company did not generate their own current, but purchased on a meter basis, he carefully checked up the apparatus they were operating until he came to the conclusion that they were not using the power they were paying for.

He obtained a test meter and made some tests which verified his investigation, and as the bills were to be O.-K.'d by him he refused to pass them. But they went through the office and were paid anyway. This matter continued for several months. Finally the consulting engineer of the company was called in to make an investigation and stated that there was nothing to his report, that the meter was all right.

Now, Antone did not like to swallow this, but said nothing until he had a chance to talk to the consulting engineer, who graciously informed him not to lose any sleep over the matter, that when he had tested as many plants as he had that he would not bother with a simple little thing like that, as he had investigated the meters and there was nothing wrong.

Things went along until the first of the month came again, when, upon the bill being presented for his O. K. he refused to pass it, and as usual it was paid at the office. But a few days later Antone received a letter stating that if he did not make good on his claim that he would be fired, and he was wanted up at the main office.

Antone went up to the manager, who advised him of the above fact, when he stated that if he could not prove his contention it was time for him to be fired. Whereupon he was told to go ahead.

Antone got one of the large company engineers whom he felt confident could conduct a test which would be correct, when they found that the constant used was fully 40 per cent higher than it should have been. As a result the company got a rebate on their power bill of several thousand dollars.

Question: What did the consulting engineer do? (He said nothing). What did Antone do? (He got fired a short time thereafter).

Moral: When you are riding a mule, soak him if he don't stand still when you holler whoa (but if you happen to be in the mule's place, stand still).

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.
DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong
604 Mission Street, San Francisco

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Rate Confusion

Electrical men, like Caesar's Gaul, may be divided into three classes—the technical, the commercial and the consumer, represented by the engineer, the seller and the buyer. Like the ancient Celtae, Aquitani and Belgae, they speak in different languages, and from this fact there has arisen no little confusion. This is well exemplified in an excerpt reprinted elsewhere from the Oakdale Leader in which the engineer's terms are translated for the ordinary reader. While this bit of humor is somewhat overdrawn, it represents the clarity of the usual layman's views of the technical engineer's work.

As the commercial man takes a peculiar delight in scoffing at the engineer's difficulty in making himself understood, it may come as a matter of surprise that his own explanations are likewise often Greek to the consumer. This is particularly the case when the commercial man tries to explain why a consumer is charged a given rate for electric service. He becomes so involved in a maze of terms which he does not understand that he completely mires and occasionally antagonizes the man whom he is endeavoring to convert to his way of thinking.

Because the various rate fixing bodies in our cities and states have decided that every man is entitled to equal service at equal rates, the central station is frequently supplying current at less than actual cost to the small consumer. To explain this, it is necessary to start on the assumption that the rates must be sufficient to bring a reasonable return on the investment. Analyzing that investment we are at once confronted by those much-mooted questions of valuation, physical, going and franchise. There are usually as many different estimates of physical value as there are estimators. No definition of going value has yet received universal acceptance. Then there arises the questions of "maximum demand" and "readiness to serve," "single rate" and double rate." These expressions are now common in the transactions of all conventions of central station men and they are apparently as far from solution as when they were first broached. Consequently, there is now need for some Moses to lead us out of the wilderness of verbiage into which we have wandered.

If those men who are actually studying these problems are so completely at variance, how is it possible to expect the average citizen to be convinced of their reasonableness. Though he may be silenced, he does not understand or believe what is being told him, and the commercial man thus undermines the foundation of public confidence which central station men are trying to establish. It is about time that the commercial men realized this fact and prepared a straightforward explanation of their methods of charging, couched in such simple language that even the most obtuse cannot fail to understand.

PERSONALS.

C. L. Cory is at Los Angeles.

F. B. Crocker of the Crocker-Wheeler Company, is at Hollywood, Cal., for his health.

James Lyman, engineer at the Chicago office of the General Electric Company is in San Francisco this week.

C. O. G. Miller, president of the Pacific Lighting Company, spent several days at Pasadena during the past week.

E. P. Hilborn, who represents the Great Western Power Company at Sacramento, spent last Tuesday at San Francisco.

A. C. Sprout has returned to his San Francisco office from an electrical engineering investigation in Siskiyou County.

C. W. McKillip, manager of the Sacramento Electric, Gas & Railway Company, of Sacramento, was a San Francisco visitor last week.

Peter Decker, president of the Decker Electric Company, San Francisco, spent the past three weeks in Monterey county on a vacation trip.

L. B. Wickersham, general manager of the United Railways, Portland, Ore., has been appointed chief engineer of the company, reporting to the president.

George Lawrence has been appointed local manager of the Western Union Telegraph Company at Los Angeles; succeeding R. H. Miller, who was promoted.

John A. Britton, general manager of the Pacific Gas and Electric Company, has been attending the annual meeting of the Pacific Coast Gas Association at Los Angeles.

Frank H. Short has returned to Fresno from the Conservation Congress at St. Paul, where he made a notable address on the subject of conservation of water power.

E. P. Shannon has been appointed assistant to John F. Stevens, president of the Oregon Electric Railway, United Railways and the Oregon Trunk Railway, Portland, Ore.

R. C. Coyne of the Kellogg Switchboard & Supply Co., Chicago, took charge of the Wisconsin territory early in September; headquarters for the present being at Delavan.

D. R. Milford, superintendent of the Kilarc station of the Northern California Power Company, visited San Francisco this week, as did also C. Bartlett, the company's manager at Willows.

C. A. Coolidge, who was recently appointed general manager of the Oregon Electric Railway, Portland, Ore., has been appointed general manager of the United Railways, Portland, to succeed L. B. Wickersham.

A. L. Searles who has had charge of the development of the new Fort Wayne electric rock drill is visiting the company's San Francisco office and superintending the operation of the drill at the Pacific Coast Electrical Exposition.

William D. Ward of the Pelton Water Wheel Company's San Francisco office has returned from a stay of two months in Colorado and South Dakota with a contract in his pocket for the water wheel end of a $1,500,000 hydroelectric installation.

Henry M. Richards, chairman of the executive committee of the Washington Water Power Company, Spokane, Wash., and formerly president of the company, was presented with a silver loving cup recently by the employees of the company as a token of esteem.

G. R. Field, assistant to H. H. Sinclair, the general manager of the Great Western Power Company, has returned from an inspection of the power plant at Big Bend. It is expected that the dam will be completed this season, with a height of 85 feet above bedrock and a width of about 330 feet on the crest.

John V. O'Brien, who rose from a messenger boy to the position of manager of the San Francisco office of the Western Union Telegraph Company, and was recently appointed a special commercial agent, died September 19th at St. Francis Hospital, from typhoid fever. He is survived by his wife, Ella O'Brien. Many expressions of regret were heard from Mr. O'Brien's friends on the Pacific Coast. The funeral took place September 21 and the interment was at Holy Cross Cemetery.

C. H. Gaunt, general superintendent of the Western Union Telegraph Company's Pacific Division, recently abolished the positions of district superintendents at San Francisco, Los Angeles and Seattle. He is reorganizing the system under a "three column" organization, according to which there will be three heads of departments in each of the three districts. The three district commercial superintendents just appointed are A. H. May, with headquarters at San Francisco; E. Boening, Seattle, and Hugh McPhee, Los Angeles. The district traffic superintendents are H. J. Jeffs, San Francisco; George D. Hood, Seattle, and R. H. Miller, Los Angeles. The district superintendents of plant are yet to be appointed.

Electrical men attending the Pacific Coast Electrical Exposition during the past week included J. W. Ricketts, Sacramento Valley Power Co., Chico, Cal.; E. S. O'Brien, Exchequer Mining and Power Co., Merced, Cal.; J. R. Harcourt, contractor, San Diego, Cal.; G. Geo. Gunderson, H. W. Johns-Manville Co., Seattle, Wash.; J. P. Crown, Peninsula Electric Works, Redwood City, Cal.; H. J. Coffee, dealer and contractor, Sonora, Cal.; W. W. Ewing, West Side Electrical Works, Portland, Ore.; F. C. Hancke, La Grange Water Power Co., Modesto, Cal.; F. W. Mitchell, manager Pac. T. & T. Co., Sonora, Cal.; R. Van der Nail'en, Oro Light and Power Co., Oroville, Cal.; W. R. Layne, Sebastopol, Cal.; C. R. Woodington, Dinuba Electric Works, Dinuba, Cal.; Mr. Ayres, of Ayres & Steventon, contractors, San Diego, Cal.

A CORRECTION.

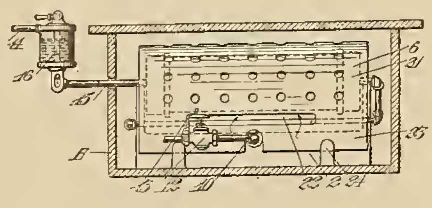
The article in the issue of July 23, 1910, entitled "Condensers for Small Stations," credited to Mr. Harry Remington, was written by Mr. Harry Pennington, the representative of the Wheeler Condenser & Engineering Co., of Carteret, N. J., at Houston, Texas.

THE LIGHT THAT FAILED.

Wednesday night the city was shrouded in darkness owing to the failure of the electric distributing plant to work properly. Enquiry of Mr. John F. Tulloch, the gentlemanly manager of the local plant, elicited the following information: The plant here is what is known as the two faced system. This method is operated by crossing the F rheostat with the lightning arrester abaft the forward exciter. Wednesday night the armature of the transformer short circuited with the brushes of the wattmeter causing the commulator to synchronise with the collector ring which closed one face of the voltmeter causing the currants to seek escape through the back door. This explanation Mr. Tulloch agrees to be the correct one and will be readily understood by the technical engineer, so as to enable the layman to understand the matter he says the essence of the juice in the ding hummer coallesced with the lead fuse which failed to vitrify properly, thus causing the current from two lines to run through one wire burning out a fuse in the substalation. The matter was been adjusted.—Oakdale (California) Leader.

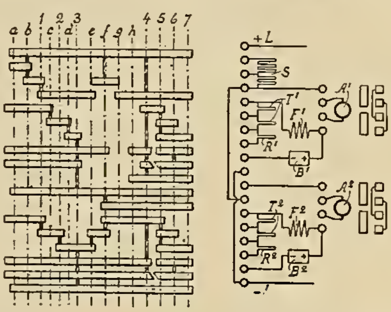
PATENTS

970,300. Oil-Burner. William H. Bradley, Half Moon Bay, Cal. The combination in an oil burner having a fuel nozzle, of a pan, a superposed horizontal cylinder, means to deliver fuel to the nozzle so that it may discharge transversely of the pan and beneath the cylinder, a perforated inclosure



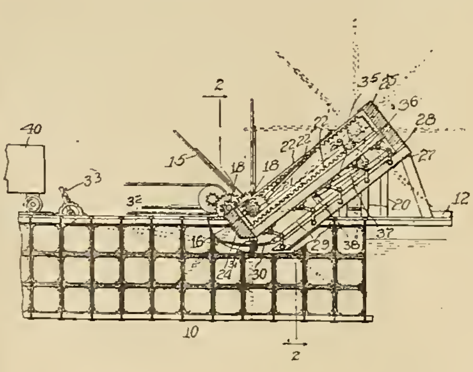
for the cylinder and products of combustion, said inclosure being outside of and spaced from the cylinder and adapted to retard the escape of the products of combustion, means to admit water to the cylinder, and a steam pipe leading from the cylinder and having jets discharging into the pan contiguous to said nozzle.

969,894. Method of and Means for Controlling Regenerative Electric Motors. Robert Lundell, New York. The method of operating a plurality of series motors arranged to drive a common load, which consists in connecting the motors to the line with each motor field in series with its armature,



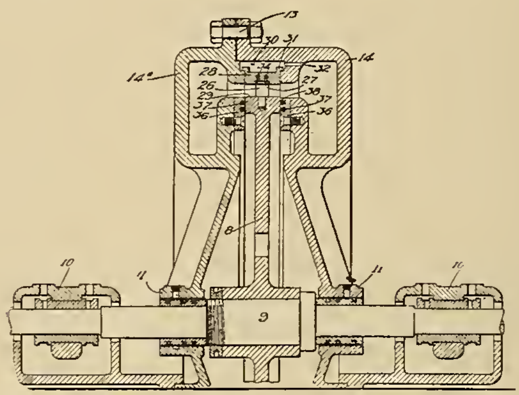
impressing independent and practically constant voltages upon the several field circuits and regulating the field excitation by varying the ohmic resistances of the said field circuits.

970,196. Hydraulic-Power Plant. James T. Dougine, Kenosha, Wis. The combination of a hull providing separated



floats and an intermediate passage, a water wheel in said passage, a shaft therefor, inclined tracks for the opposite ends of the said shaft, bearings for said shaft ends communicating with said tracks, pinions upon the shaft ends, rack members disposed for co-operation with the said pinions to cause the wheel in its rotation to elevate or lower itself upon the inclined tracks, and means for simultaneously shifting the rack members associated with the opposite pinions to cause either up or down movement of the shaft.

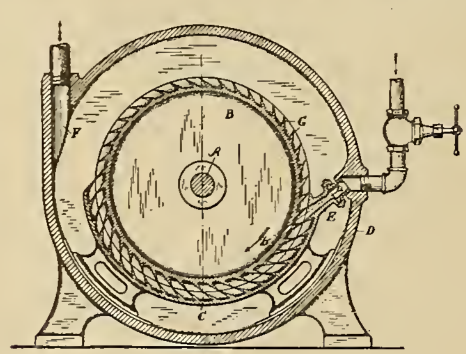
969,821. Re-entrant Turbine. George Westinghouse, Pittsburg, Pa. In an elastic fluid turbine, a rotor element provided with a row of shrouded blades, a casing surrounding said element, fluid discharge devices forming with said element, re-entrant stages extending circumferentially of said



turbine, yieldingly mounted packing strips located above and below the working faces of said blades for minimizing the escape of working fluid from stage to stage, and means for limiting the movement of said strips toward said element.

969,809. Alternating-Current Magnet. Arthur Simon, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. In an alternating current magnet, in combination a plurality of coils for producing magnetic fluxes of different phase, means forming magnetic circuits or paths for said fluxes in the same plane, said paths being adapted to distribute the fluxes symmetrically about a common axis.

970,193. Turbine. Willis G. Dodd, San Francisco, Cal. A steam turbine comprising a rotating element and a stationary element, said elements between them forming an annular elliptical chamber, within which are located a series of guide vanes, constituting a series of tangential chambers,



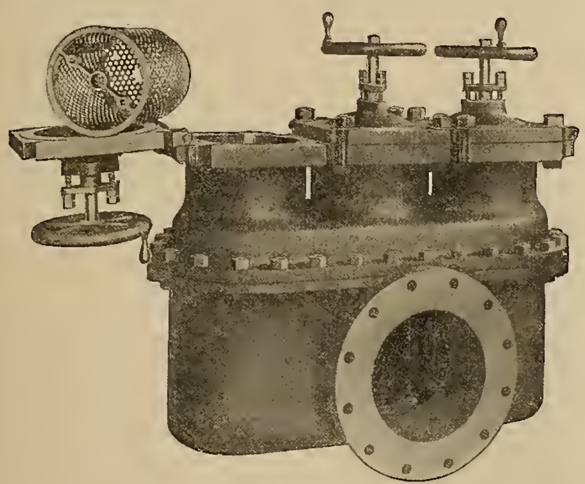
forming paths of constant deflection for the impelling medium, an expanding nozzle located within the first chamber of the series, a neutral axis or annular space between the stationary and rotating elements, formed by cutting away the guide vanes.

INDUSTRIAL

MULTIPLE STRAINERS.

Solid foreign matter in water such as ice, rocks, sticks, leaves, etc., has wrecked many pumps. It has stripped the blades from centrifugal pumps and put the valves of reciprocating pumps out of business many times and even when such solid matter has gotten past the pumps without doing severe damage it finds its way into surface condensers and boilers causing untold trouble.

Nearly all sources of water supply, especially for circulating water, contain an immense amount of suspended matter, and while attempts are often made to remove this by placing a strainer around the suction pipe foot valve, this only transfers the source of trouble. The strainer soon becomes clogged and it is necessary to shut off the pumps while it is being cleaned. If the water is being used for condensers this means the loss of the vacuum and throwing an extra load upon the power equipment of the plant and if there is no reserve power it means shutting down the plant.



Lagonda Multiple Strainer.

In order to get around these difficulties, the Lagonda Manufacturing Company of Springfield, Ohio, has recently perfected a multiple strainer for removing impurities in feed water, circulating water, etc. These strainers can be installed either outside, or inside of the buildings and in any position, horizontal, vertical or inclined. They also have the advantage that they are made up of different sections which can be cleaned, one at a time, without interrupting the flow of water.

The strainer consists of a cast-iron body having a number of removable strainer baskets, the number depending upon the size of the line. As these baskets can be easily removed for cleaning, without shutting down the pumps, the mesh is made very fine, they thus eliminate more foreign matter than any other type of strainer.

Water enters through an inlet pipe, passes up to the top of a valve chamber, where it divides, going down through all of the baskets in multiple. When it is desired to clean the strainer, one of the baskets is drawn to the upper part of the chamber by turning the hand-wheel, at the same time the valve collar is forced tightly against the valve seat and the valve disc on the bottom of the basket seats on the valve collar. This is all done automatically and entirely shuts off the water supply from the section containing the basket to be cleaned. By means of a small by-pass the pressure in this chamber is now relieved and the bolts at the top loosened and the flange cap tilted over exposing the basket. The basket can now be taken out and cleaned. In replacing the basket the operations are exactly the reverse. The next basket can now be removed in the same way and the whole strainer cleaned without shutting off the water. Should an obstruction rest upon the top valve collar, the basket when raised to cleaning position, will have a tendency to tilt the obstruction either into the basket or out of the way of the valve. This is due to the fact that the basket travels nearly its entire distance before the lower valve disc comes into contact with the lower seat of the valve collar.

The effective straining area of a Lagonda strainer is from 2¼ to 4 times the area of the pipe line and in removing one basket for cleaning the straining area is not reduced more than 30 per cent, thus the pipe line is never throttled in the process of cleaning. One important item concerning these strainers is that all of the internal parts subject to the action of water are made of bronze thus eliminating all troubles from corrosion. Neither are there any leather or rubber washers used.

Lagonda multiple strainers are built in sizes from 2 to 48 inches, having two to six baskets, the number depending upon the size of the strainer. They are also suitable for use in either suction or pressure lines and are built to stand working pressures up to 200 lbs. per sq. in. In practice one of the baskets is left out of service so that in case the baskets in use should become clogged the clean basket can be quickly lowered into service. Further details concerning the various uses for these multiple strainers can be had by addressing Chas. C. Moore & Co., Engineers, San Francisco.

SWITCHBOARD MATERIALS.

BY C. F. ADAMS.

The early history of electric lighting records little of interest to the student of switchboards. Then, electric instruments were generally mounted on some variety of hard wood, and the term "switchboard" was a correct descriptive title. Arc light machines were of ten and sixteen lamp capacity and the pioneer incandescent lamps were operated at from 50 to 70 volts. A 30 kw. dynamo was a large machine for those days. The insulation question, and the operating temperatures of the instruments and conductors was a matter of small concern. Instruments, switches, fuses and lighting arresters were all mounted on wood bases. Wood was found to be unstable, even when carefully varnished, warping from heat or moisture, and also, from some "unknown cause," the wood mountings were occasionally subject to fire.

The use of small slabs of slate for the mounting of fuses and plug switches was the first application of fire-proof material to instrument mounting. A larger slab, mounting several instruments was a natural development, these slabs being mounted on a skeleton wooden frame.

As lighting and power systems grew and the importance of continuous service was recognized, the question of fire risks was carefully studied. Wood was abandoned and the fire-proof switchboard was a reality.

The decorative element in polished marble or enameled slate was fully realized, and the careful matching of shade and grain was an art in itself. The monumental character of those structures served to impress the public mind, and added the element of Art to the field of the mysterious. In one Southern power house a colored "field hand" paid this tribute. "Boss, ef I knowed thet when I wus daid un gone, I cud hav one of them marbles fur a hed stun, I'd be willin' to quit libin t'morro."

For handling high potentials and heavy currents the oil switch was evolved, and the era of the oil switch wrought

disaster for the ornamental marble or slate structures. The back and edges of slabs were varnished or otherwise treated to resist the invasion of oil. A heavy "short," expelling oil in a flaming shower has damaged many a handsome slab. The crowded oil switch mounted in tiers on the back of a "fireproof" board has almost disappeared. These essential devices are now relegated to the concrete or asbestos wood cell for obvious reasons.

For purposes of insulation, the limits of quarried materials were soon reached. A hydroscopic material is affected by the atmosphere, and the marble slab was often boiled in paraffine to render it more stable as an insulator. Fine metallic veins were ever present and those would lead to current creepage and ultimate disaster. In case of fire these treated slabs burned like a piece of "fat wood."

The advance of the art called for a better material, a material of high permanent insulating quality, and at the same time fireproof, as regards combustion and capable of sustaining high heat without disintegration. A material mechanically strong and free from the breakage and defacing incident to stone. A material easily machined and permanent of form and structure. A material impervious to moisture or oil, and a surface capable of a pleasing finish. These are the desired qualities of the ideal switchboard material. No single natural product was available with such characteristics.

The persistent efforts of the chemist and the skilled manufacturer has solved a product that is being largely employed for switchboard work. It is known as J-M Ebony Asbestos Wood, composed of Asbestos fibre—and other insulating and water-proofing materials. Two years' observation of J-M Ebony Asbestos Wood in service shows no deterioration, either electrically or mechanically. It is employed for switchboard panels, high tension switch tops, air switch or fuse bases, for barriers, and other uses. The external finish given this material in service is generally a dead black varnish.

In a test of some 2-inch J-M Ebony Asbestos Wood switch tops for 60,000 volt switches, metal plates 2 in. by 4 in. were placed on the surface 6 inches apart and the voltage raised to 40,000 volts before there was any apparent surface leakage, nor would this voltage puncture these tops which were two inches thick, although marble would have failed at about 10,000 to 12,000 volts.

WESTINGHOUSE CO.'S EXHIBIT AT N. W. ELECTRIC LIGHT & POWER CONVENTION.

One of the attractive features of the recent convention of the N. W. Electric Light & Power Association, as held on board the steamer "Queen" on the waters of Puget Sound, was the exhibit of the Westinghouse Electric & Mfg. Co., as shown by the accompanying illustration. The space allotted was utilized to the greatest advantage, as shown.

The company had on display their new line of electrically heated apparatus, also the latest types of motors, and a complete line of Westinghouse wire-type tungsten lamps from 25 to 500 watt capacity were on exhibition and attracted considerable attention and favorable comment. The coziness of the exhibit appealed to everyone and during the evenings and at other times when there were no business meetings, it proved to be an attractive place for central station men to congregate and discuss apparatus.

Westinghouse Co.'s Exhibit at N. W. Electric Light and Power Convention.

NEW CATALOGUES.

"Condensers for Small Central Stations" is the title of a 24-page pamphlet published by the Wheeler Condenser & Engineering Company, of Carteret, N. J., in which is reprinted a lecture delivered before the Missouri Gas, Electric & Street Railway Association.

The 1910 catalogue of wiring devices manufactured by the Bryant Electric Co., and the Perkins Electric Switch Manufacturing Co. of Bridgeport, Conn., is being distributed to the trade. The "superior devices" listed and illustrated include adapters, cutouts, fuses, receptacles, rosettes, sockets and switches, there being a total of 1547 devices listed, 383 of which are here listed for the first time.

NEWS NOTES

FINANCIAL.

ASHLAND, ORE.—Bids will be received at the city recorder's office up to September 27th for the purchase of $25,000 electric light bonds.

VALLEJO, CAL.—Bonds to the amount of $40,000, the proceeds of the sale of which will be devoted to improvement of the municipal water system, have been voted at a special election.

ONTARIO, CAL.—The Trustees of the town of Ontario have postponed the special election on the bond proposition from September 16 to a date to be selected the latter part of the month. The bond issue was for $175,000 for a water system and other works. The reason given is that the ordinances and notices had been signed by the temporary president of the board instead of by the regularly elected chairman.

SAN FRANCISCO, CAL.—Plans have been made by the Public Utilities Committee of the Board of Supervisors for active prosecution of the work on the city water project in the Lake Eleanor district. A recommendation was adopted that $3,000,000 worth of the Hetch-Hetchy bonds be offered for sale. The first $1,000,000 to be sold next February, the second $1,000,000 the following August and the third $1,000,000 in August of 1912. It was also recommended that the Finance Committee transfer $10,000 from the Emergency Fund for the immediate use of the engineer's department, to prosecute the work necessary in and about Lake Eleanor valley. Of the first $1,000,000 worth of bonds sold $600,000 will be necessary for the purchase of the remainder of the William Hammond Hall properties, on which the city has an option for one year, of which over six months has already passed. Another $50,000 will be needed to carry on the work made necessary by Secretary of the Interior Ballinger in ordering an investigation of all the available water systems within reach of San Francisco.

INCORPORATIONS.

ELMA, WASH.—The Elma Telephone Company has been incorporated for $10,000 by C. H. and S. L. Palmer.

PE ELL, WASH.—The Central Power Company has been incorporated for $15,000 by L. A. Webb and Phil S. Locks.

WHITTIER, CAL.—A portion of the Rancho Potrero Grande tract consisting of about 200 acres of land has been sold. The property is a part of the La Merced grant and belonged to the Lucky Baldwin estate. A water company has been organized under the name of the Potrero Water Company and will begin to develop for water as soon as they get a charter. Officers of the company are: President, A. F. Taylor of Glendora, Cal.; Vice-President, A. H. Cheney of Los Angeles; Secretary, B. F. Arnold of Whittier, Cal.

GIFFORD, IDAHO.—The town of Gifford will soon have a water system for domestic and irrigation purposes. Residents of the town and surrounding neighbors have subscribed for stock in the Gifford Water Supply Co., limited, articles of incorporation of which have been filed with the county auditor and recorder, with capital stock of $10,000. The company is incorporated for the purpose of constructing and operating a plant for pumping water, to build reservoirs and put in tanks for installing water to be used under pressure, to lay water mains and pipes and put in hydrants and to supply water for domestic, irrigation and fire purposes. It is the purpose to begin the installation of the plant at once.

TRANSMISSION.

EUGENE, ORE.—The Northwestern Corporation has been granted a franchise to use the Lane County roads for its power line from Springfield to Albany.

ALBANY, ORE.—The county court has granted a franchise to theTri-State Railway & Power Company for an electric power line from Eugene to this place.

TACOMA, WASH.—Count Kokudava and two other wealthy Japanese arrived last week from the East, where they purchased machinery for a $100,000 electrical plant to be installed at Kyoto.

GRANGEVILLE, MONT.—The Grangeville Light & Power Company is engaged in making extensive improvements here by enlarging the power station, reconstruction of the power line and construction of a modern building.

SPOKANE, WASH.—H. E. Shallenberger, head of the International Lead & Iron Company, has announced that a town is being laid out at Salmon Rapids and preliminary surveys have been made for the installation of a 65,000 horsepower electric plant on the Salmon river.

SAN BERNARDINO, CAL.—The Board of Supervisors will receive sealed bids up to 2 p. m., October 10th, for a certain franchise applied for by the Pacific Light & Power Company, for the right to erect and construct and for a period of 40 years to maintain and operate poles and other superstructures, for the transmission of electricity and to lay, maintain and operate wires, cables and other appliances for transmitting and conducting electricity upon the highways of this county.

TRANSPORTATION.

WOODLAND, CAL.—The construction of the Vallejo & Northern Railway has commenced in the breaking of ground on Second street in this city.

BANDON, ORE.—J. H. Somers, representing the Coos Bay Traction Corporation, is here with the proposition of raising $50,000 for the construction of an electric railway from Coos county to Grants Pass and Roseburg.

MEDFORD, ORE.—John R. Allen, of the Southern Oregon Railroad & Electric Company, states that construction work on the proposed electric interurban railway to connect Medford, Ashland and Grants Pass will start soon.

LOGAN, IDAHO.—The County Commissioners have granted the amended franchise for the operation of an interurban electric railroad to Lee Neilsen and his associates. The route is from Wellsville to Hyrum, thence along the east edge of the valley to Logan, touching the towns of Millville and Providence. From Logan the line goes through Greenville to the Idaho State line, passing through Hyde Park.

MARTINEZ, CAL.—The Robert Dollar Company has delivered 60,000 ties at Bay Point for the Oakland and Antioch Railway and three carloads of rails were laid down at that point on the same day. The engineering crew of the Oakland and Antioch Railway is at present in Martinez finishing the surveying work for the road and the laying of rails and ties will be started this week. The coaches for the road have also been ordered and will be delivered about November 1.

SAN FRANCISCO, CAL.—Steps have been taken by the Public Utilities Committee of the Board of Supervisors to

push forward the construction of the Geary street railroad. A formal resolution has been adopted recommending that the Board of Public Works be authorized to enter into contracts for the purchase of rails to the maximum amount of $130,000, and a second resolution provided for the appropriation of $5000 for the expense of formulating definite plans for beginning the work.

SAN FRANCISCO, CAL.—Notice is given that the annual meeting of the stockholders of the Northern Electric Railway Company, a corporation, will be held at the office of the company, room No. 1101, in the Alaska Commercial Building, situated on the northeast corner of California and Sansome streets, in the city and county of San Francisco, State of California, on Monday, the 26th day of September, A. D. 1910, at he hour of 2:00 o'clock p. m., of that day, for the election of directors for the ensuing year, and for the transaction of such other business as may come before the said meeting.

SAN FRANCISCO, CAL.—The franchise for the proposed extension of the Parnassus avenue car line from the Affiliated Colleges out to Ninth avenue and up Ninth avenue to Pacheco street, for which the residents of the Sunset District have been working for two years, and towards which they subscribed $20,000, is almost assured. The bid of Thos. W. Watson, representing the residents of the Sunset District has been approved by the Public Utilities Committee and a resolution passed recommending its sale to Watson. The line for which the franchise is asked, while only about a mile in length, will tap a considerable district in the Sunset and will open up for settlement some of the most desirable land for homeseekers in the city. It is thought that the line will be completed by next year.

ILLUMINATION.

PRINCE RUPERT, B. C.—The Tsimpsean Power Company will erect a gas plant here. John Cotes of London has the contract.

MARTINEZ, CAL.—The Richmond Light & Power Corporation bid for an electric franchise over the streets in this county, has been accepted by the Board of Supervisors.

STEWART, B. C.—The Portland Canal, Light, Water & Power Company, in this district, proposes to build a plant on American creek and will spend about $100,000 in the undertaking.

SPOKANE, WASH.—Work will proceed immediately by the Washington Water Power Company to deepen and straighten the channel of the Spokane river for 1500 feet below the Monroe street bridge.

ONTARIO, CAL.—The Ontario-Upland Gas Company plans improvements to the extent of over $2500. It will install a gas booster which will raise the pressure in the tanks at the noon hour, when the consumption is the heaviest.

WAILUKU, H. T.—When the Wailuku Electric Company first received its charter it was intended to install a large plant suitable for light and power. The company is now going ahead on a lighting plant only. It is intended to install a 1000-light plant.

UPLAND, CAL.—An ordinance has been passed granting a franchise to the Pacific Light & Power Company to erect poles and string wires along Orange avenue in this city and to connect with the Tenth street line. A power house will probably be erected on Orange avenue by the company.

EUGENE, ORE.—An announcement has been made by Chief Engineer White that arrangements are being made for building a holder for the new water plant to have a capacity of 150,000 cubic feet. He also states that an entirely new water gas plant will be installed at once consisting of two "sets" of a capacity of 250,000 cubic feet each per day.

TELEPHONE AND TELEGRAPH.

WATERVILLE, WASH.—A franchise was granted the Farmers' Telephone Company for a system in this city.

ASHLAND, ORE.—The City Council has voted to cancel the franchise secured by E. C. Sharp on account of failure to begin work.

GREAT FALLS, MONT.—The Great Falls Automatic Telephone Company will install a private branch telephone exchange in the $400,000 Rainbow hotel, nearing completion.

MISSOULA, MONT.—The Rocky Mountain Bell Telephone Company is engaged in repairing the burned telephone lines between here and Wallace, Idaho; 40,000 ft. copper wire and 800 poles were wiped out.

PENDLETON, ORE.—The Pacific Telephone & Telegraph Company is engaged in constructing a long distance telephone line between Walla Walla and this place. An expenditure of $20,000 will be made to improve the service of this city.

SAN FRANCISCO, CAL.—The Alaska Steamship Company has contracted with the United Wireless Telegraph Company for the equipment of their steamship La Touche with a one-kilowatt plant. The installation on this boat is now being rushed and it is expected will be completed in the course of a day or two. The Alaska Steamship Company at the present time has the following ships equipped with this system: Victoria, Northwestern, Dolphin, Seward, Olympia and Jefferson. The steamship Yucatan of this same line was equipped with the system at the time of the disaster. Valuable service was rendered by the use of the wireless on this ship.

WATERWORKS.

LINDSAY, CAL.—Authority is granted to W. S. Howe and assigns to lay water pipes in the streets and alleys of certain additions to this town.

LEWISTON, IDAHO.—The Council will install an additional pump at the water plant to cost approximately $2500, which will be installed the coming year.

TACOMA, WASH.—The Council has passed an ordinance granting to the Tacoma Water Supply Company a permit to lay and maintain water pipes in certain streets in the city of Tacoma.

TACOMA, WASH.—Tre International Contract Company of Seattle will probably receive the contract for building the intake and headworks of the Green River gravity water plant. The engineer's estimate on the work is $70,000.

GLENDORA, CAL.—At a meeting of directors of the Citrus Belt Water Co., it was decided to sink the present well deeper, replace the board curbing with curbing and install a new pump. The estimated cost of improvements is $10,000.

HOQUIAM, WASH.—At the next meeting of the Council a franchise will be presented providing for a 25-year franchise to lay and maintain water mains and pipes in Histler's Addition to Aberdeen. The application has been made by Rudolph Histler.

SAN FRANCISCO, CAL.—Permission has been granted to the Ames-Harris-Neville Company to lay steam pipe and return underground across Potrero avenue at the crossing of Alameda street, from the building of the Stauffer Chemical Company, to a certain building, the property of Mr. Ames.

WOODLAND, CAL.—D. B. Ridby of the Oakland Iron Works appeared before the Trustees at its last meeting with a blue print of plans for an auxiliary waterworks plant. The members of the board approved the plans but no further action was taken, as the site for the plant will not be located until the results of the boring tests for water are known.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 14 — SAN FRANCISCO, OCTOBER 1, 1910 — PER COPY, 10 CENTS

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

JOURNAL OF ELECTRICITY
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Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXV — SAN FRANCISCO, OCTOBER 1, 1910. — NUMBER 14

PACIFIC COAST ELECTRICAL EXPOSITION

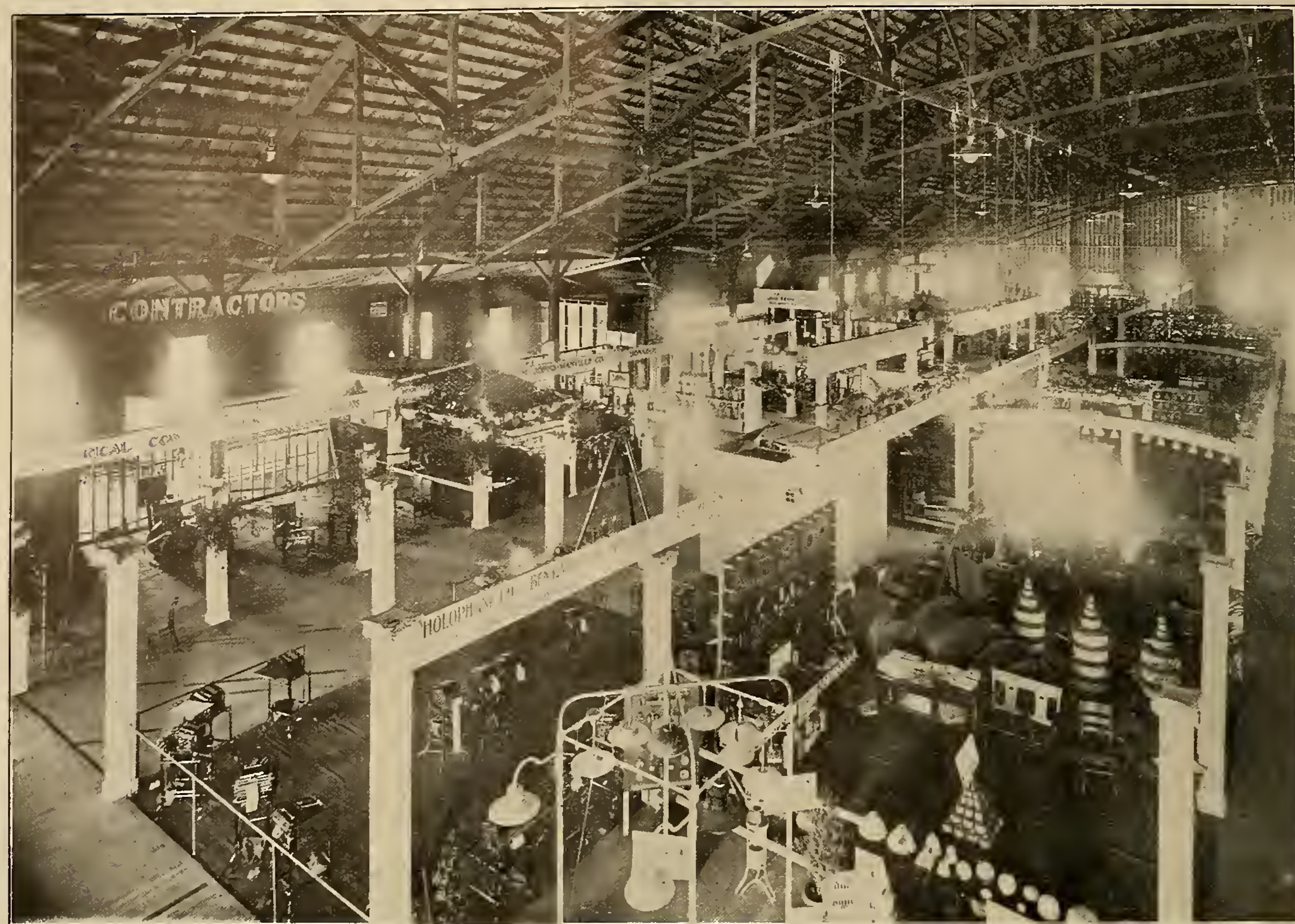
The Pacific Coast Electrical Exposition was brought to a brilliant culmination on Saturday night, September 24, after a successful run of eight days and nights. This, the first electric show to be held west of the Rockies, proved to be more successful than anticipated by even the most sanguine, a conservative estimate placing the total attendance at 40,000. There is now a strong likelihood that this expositon will hereafter be held annually, a large number of exhibitors now wishing to double and even quadruple the space they used this time. The gate receipts were such that a substantial return is assured to each one who took space.

General View Pacific Coast Electrical Exposition

Most of the exhibits were calculated to appeal to the public fancy. There was consequently little to indicate Western pre-eminence in long distance transmission of high tension power, but much to interest the small user. Yet withal, there was many an engineer who found his time profitably engaged in studying some of the newer, if less spectacular, displays.

As compared with the Eastern shows, the spectacular was lacking. An occasional thrill was induced by the exhibition of the apparent inconsistencies of high frequency current in its effects on the human system. The riot of light caused many to marvel, an electric rock drill added a bit of local mining color and a touch of rural life was introduced by electrical milking machines, together with the necessary cows. The wireless telegraph was always the center of an interested throng, as were also the telautograph and directograph.

The prime idea of the show, to educate the public in the many varied uses of electricity, was well carried out. Its stimulus should be beneficially felt for a long time to come in the way of increased demand for electrical apparatus.



Panoramic View of the

Lighting.

The most conspicuous feature, numerically and in point of brilliancy, were the electric lamps. The regular lighting system for the Coliseum provided fifty-six 250-watt tungsten lamps suspended overhead so as to give good illumination to all points on the floor. Naturally one of the most important classes of exhibitors were the lamp manufacturers and their products contributed greatly to the resplendence of the effect.

The National Electric Lamp Association, exhibiting on behalf of its member companies, occupied four booths facing the main aisle in the center of the building and their engineering department gave an extensive exhibit of the latest developments in incandescent lamps. The booth decorations were especially effective, being undoubtedly the most elaborate of any at the show. The entire booth was outlined by decorative arches supported by columns surmounted by gilt capitals and eagles of staff work. In the center of each arch was placed the "N. E. L. A." monogram, and across the outside of the arch was painted, in characteristic old English type, the name of the association. Various sizes of Mazda lamps and Holophane reflectors were suspended from the bottom of the arches. A reception room for the association's guests was built within the booth. This took the form of a Spanish pergola, decorated with autumn leaves and beaded portiers.

The lamp exhibit included three racks, upon which were mounted the various sizes of 110 and 220-volt Mazda and tantalum lamps, the Mazda street series, and the Mazda sign lamps. The new double-wound tantalum lamp for street-car use was exhibited on a rack in a comparative test with the old 64-watt carbon lamp. The different types of Holophane reflectors, of both the Stilleto and Standard lines, were also on display.

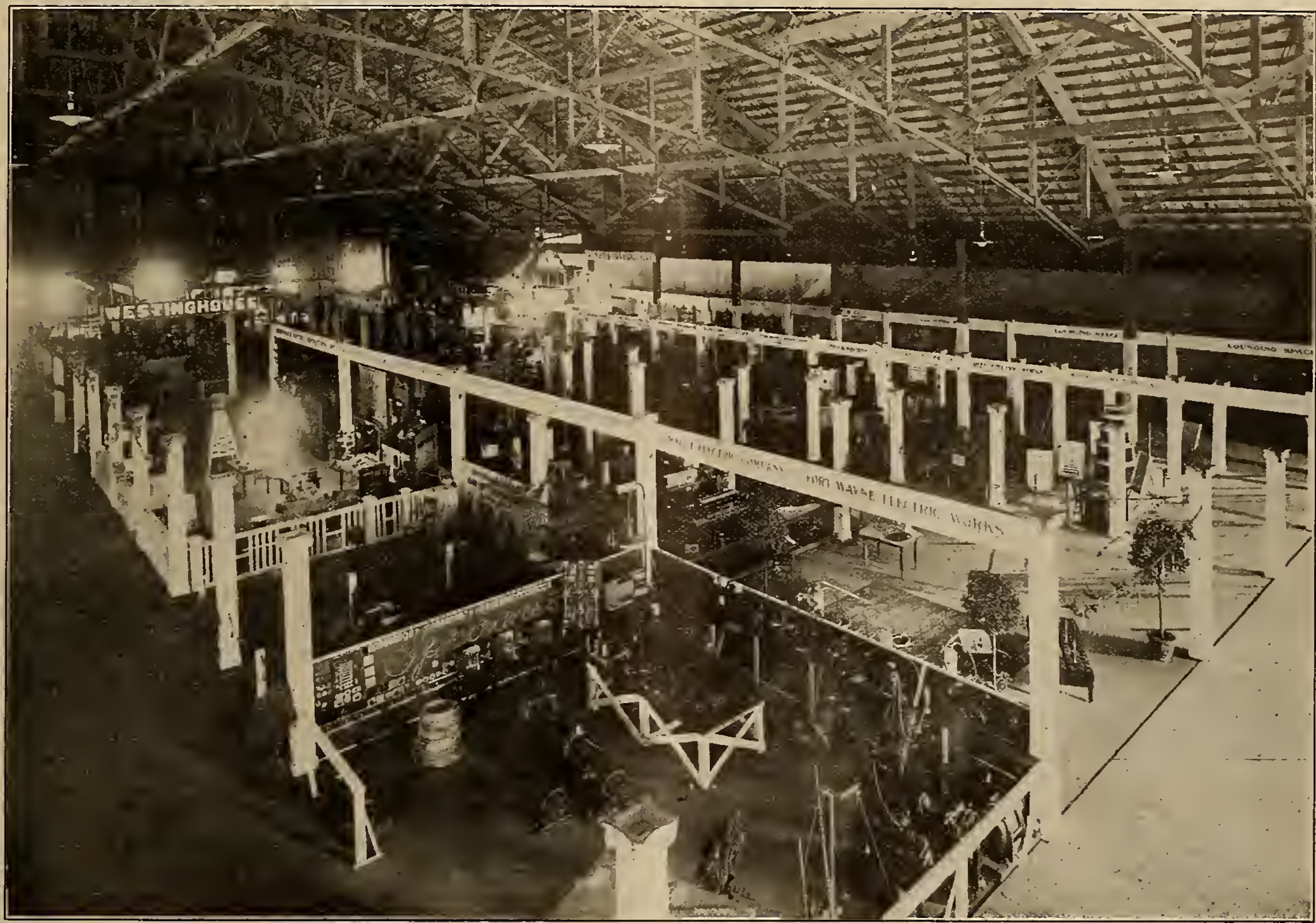
A complete electric lighting outfit for automobiles, including the searchlight, headlights, sidelights, taillight and limousine lights were mounted on a display board, and shown burning as in actual service.

An interesting historical feature of the exhibit was the collection of Goebel incandescent lamps. These lamps were made in the early sixties, were operated from batteries, and were used for advertising purposes in New York City.

A device which showed the principle of the Bunson photometer was exhibited, as well as a "mirror rotator," which illustrated one way of obtaining the light distribution about a lamp.

Two novel features of the exhibit were the samples of 500 and 400-watt Mazda lamps, and the new drawn wire Mazda lamps. Several types of the latter were shown, among which were the 30 and 60-volt train lighting, as well as the regular 40-watt, 110-volt lamps. The drawn tungsten filament is something entirely new, and the exhibit of lamps with these filaments was viewed with interest by the thousands of visitors.

Perhaps the most striking illustration of the effulgence of the Mazda lamp was contained in the



Pacific Coast Electrical Exposition

booth of the **General Electric Co.**, where it was displayed as the "sun's only rival" in a manner that called forth comment from all.

The Westinghouse Electric and Manufacturing Co. exhibited lamps of all types and all sizes on two revolving disks, both low and normal voltage being supplied on each rack. As these lamps contained a large number of colored bulbs it added greatly to the spectacular effect of this company's exhibit. A model street series tungsten system was also displayed.

Joseph Thieben & Co. made a special exhibit of Star and Eastern "Mazda" lamps whose effective arrangement added to the attractiveness of this exhibit. Included in it also was a full display of Howard miniature automobile and candelabra lamps as well as Novelty electric signs and Dull's flashers.

Franklin "Mazda" lamps were exhibited by **Holabird-Reynolds Co.** in connection with their other features hereafter to be mentioned. Linolite lamps for both desk and window lighting were exhibited by **H. W. Johns-Manville Co.** Fostoria lamps were displayed by **Brooks-Follis Co.** and Cooper-Hewitt mercury arc lamps by the **Aylesworth Agencies.** The **Brumfield Electric Sign Co.** had an elaborate exhibit of standard and colored signs. By means of Pyro flashers they also showed a number of interesting effects in moving signs.

Of even greater brilliancy than the incandescent lamps were the many kinds of arc lamps displayed. From the searchlight on the roof and the flaming arc lamps outside the building to the Trucolor lamps on the inside the electric arc maintained its reputation for intensity.

The General Electric Co. by means of the mercury arc rectifier were enabled to display direct current luminous arcs and flaming arcs, laying particular emphasis on the mechanical construction of their lamps.

Chas. L. Kiewert & Co. displayed a complete line of flame and carbon arc lamps and supplies, including the Siemens flaming arc and the Aurola, Alba, Triplex, Economy and Lilliput arcs. A show window, displaying gentlemen's furnishing goods, was lighted by a Trucolor arc which brought out to good advantage its close approximation to sunlight. A moving picture machine operating with their "Bio" carbons for projecting purposes was also in operation.

Parrott & Co. attracted much attention with their exhibit of Grant flaming arcs, just to the left of the entrance. **Jos. Thieben & Co.** exhibited a number of American searchlights and also Stave flaming arcs.

Communication.

Second in numerical importance only to the lights, were the various means of communication exhibited.

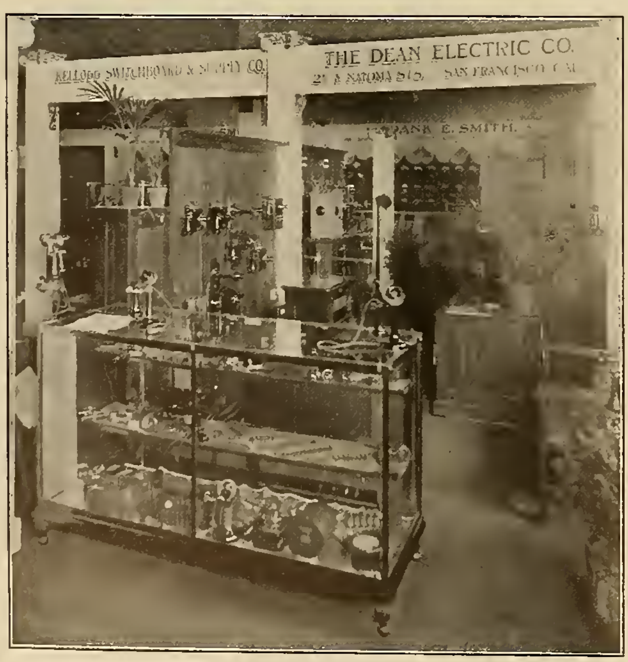
The Bay Cities Home Telephone Co. equipped each booth with one of its automatic instruments for the use of all exhibitors, free of charge. At its own booth the company exhibited a working section of its automatic selector system which was explained to all interested by a corps of courteous attendants. The company also showed various types of instruments

National Electric Lamp Association

which it is installing, and provided free telephone service for visitors.

The Pacific Tel. & Tel. Co. had three sound-proof booths at which local service was furnished free of charge to all at the show. On each evening long distance connection was established with some one of the Pacific Coast cities such as Los Angeles, Portland, Seattle or Spokane and free service given to all those that desired to use it.

The Dean Electric Co. exhibited a standard private branch exchange board operating in connection with such automatic equipment as is now being used by the Bay Cities Home Telephone Co. One of the most interesting features of their exhibit was a police Flashlite switchboard operated in connection with a police box and showing the method of calling a policeman on his beat by means of a brilliant red light flashing in the box whenever the desk-sergeant so desires. Another innovation was a complete exhibit of the new wayside service, whereby anyone equipped with the hand microphone provided, can communicate with a Central by plugging in a box placed along well traveled roads and in city streets. This is of particular use to delivery wagons and automobiles. The exhibit also included a common battery harmonic switchboard together with telephones and harmonic converter and ringing machine. A full line of Dean telephones, including the new bedside type, were exhibited.



The Dean Electric Compa..

The Kellogg Switchboard and Supply Co. had a most interesting display of telephone apparatus, laying particular stress upon their railway signal system, which is fast being adopted by all the leading railroad companies as a substitute for the telegraph service. The convenience and accuracy of this method, as well as its economy, was graphically pointed out by the exhibit. A full line of Kellogg telephone and switchboard parts were displayed in glass show cases, including special telephone adaptations for mines and for power companies.

The Telephone-Electric Equipment Co. showed an interesting display of Stromberg-Carlson telephones, the display being designed principally for architects and contractors, as it featured the inter-communicating telephone system for residences and business houses.

The Direct Line Telephone Co. had an exhibit of interest to factories and other places requiring a convenient inter-communicating service which can be rendered absolutely secret.

De Veau telephones were exhibited by the **Electric Railway and Manufacturers' Supply Co.**

Department of Electricity

One of the most novel exhibits was that of the **Department of Electricity** of the city and county of San Francisco, which showed a complete working system of the fire alarm and police signal apparatus as in use in San Francisco. The exhibit comprised three outside fire alarm boxes and a police box connected with their respective central station boards, fire house boards and police station boards, each of which were equipped with many special signaling devices. Particular interest attaches to this exhibit because all the apparatus is made by the department and the system as installed is one of the most complete and up-to-date in the country.

The Directograph was another means of communication which created much popular interest. By means of this machine it is possible to send news from a central station by means of a typewriter and have it mechanically written on a large bulletin board simultaneously at a large number of places. Its purpose is particularly for the transmission of stock exchange reports, prize fight and baseball returns. Its principle of operation depends upon the electrical control of a large number of magnets which move a marking pen upon the board, tracing out the desired words.

The Gray Telautograph Co. exhibited their instrument for electrical transmission of handwriting, which proved of peculiar popular interest.

The National Dictograph Co. demonstrated the Dictograph system by means of which the executive is placed in instant communication with all his assistants without the necessity of holding an earpiece or talking into a transmitter, as the instrument transmits speech from any reasonable distance within the limits of an ordinary room, the receiving end being further provided with a small loud speaking horn which amplifies the sound.

A full line of Monarch telephones as well as the Monarch time system was exhibited in the booth of the **Aylesworth Agencies.**

A most noteworthy exhibit was that of the **Western Union Telegraph Co.,** this being one of the few electrical shows for which this company has prepared an exhibit. It included a complete system for sending and receiving messages with operators and messenger boys. Particular emphasis was laid upon their new night letter service and an excellent object lesson given to the public of the great work done by this company.

A wireless telegraph system was installed by the Exposition Company and placed in charge of Mr. William Hanscom, the electrical engineer for the exposition. This feature attracted no little attention from the visitors who were interested in the mysteries of the wireless.

Kellogg Switchboard & Supply Co.

General Electric Company

The San Francisco Gas & Electric Co., occupying one of the large central booths, made no attempt at a working display, but provided a beautifully furnished reception and lounging room with maid in attendance. Here the visitors could rest, ask questions and look over the current magazines, all the while being impressed with the company's motto, the "house of courtesy."

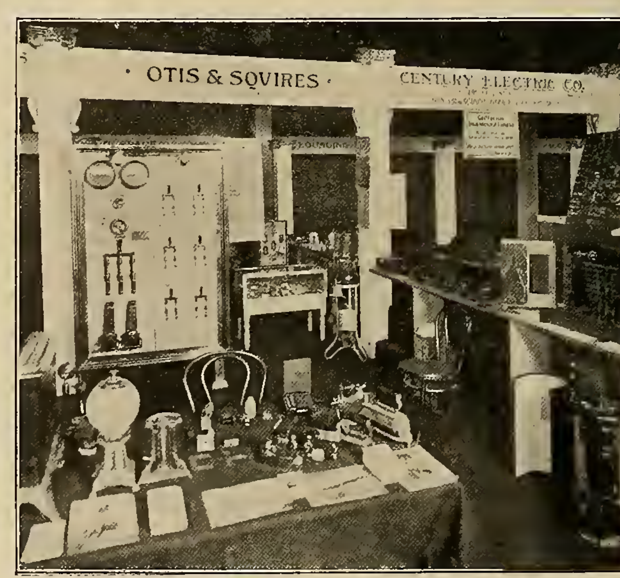
Electric Heating.

Third numerically, and perhaps first in popular interest, were the electric heating appliances which were exhibited by a large number of companies. Naturally the largest crowd congregated where there were demonstrators, particularly at the large booth of the **General Electric Co.**, one-half of which was elaborately fitted up as an electric dining-room and electric kitchen. The dining-room was handsomely furnished in Mission style, with a drop light on the center table, a luminous radiator in the fireplace and copper chafing dish, percolator and tea kettle, all electrically operated, on the serving table. The electric kitchen was equipped with a standard No. 2 cooking and baking outfit which consisted of a wooden range equipped with all manner of electrically heated devices, each device containing the heating element as an essential part. The new type No. 1 domestic range was here shown for the first time. It consists of oven, broiler, three hot plates and a warming compartment, with the necessary switches and devices for connecting portable devices. These devices are legion in number, including double boilers, frying pans, waffle irons, toasters, tea kettles, coffee percolators, broilers, pancake cookers, water heaters, ovens, etc.

The Telephone-Electric Equipment Co. exhibited an equally complete line of Simplex heating devices, as did also the **Westinghouse Electric & Mfg. Co.**

Each of the three above companies exhibited electric irons, as did likewise the **Holabird-Reynolds Co.**, who demonstrated the Pacific Electric Mfg. Co.'s Hot Point iron.

Closely allied with these electric irons was the exhibit of the **American Ironing Machine Co.**, which included a Simplex electric ironer (motor operated) and a Thor electric washer and wringer. A 1900 washing machine, as well as a number of Westinghouse heating appliances were exhibited by the **Levy Electric Co.**, Electrical water heaters shown included the Diamond and Cutler. The Consolidated Electric Appliance Co., represented by **Otis & Squires**, displayed Pluto electric irons, electric radiators and instantaneous water heaters.



Otis & Squires

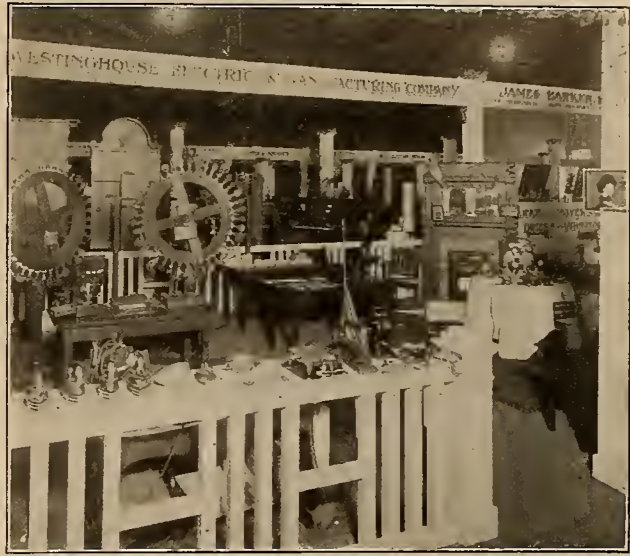


Exhibit of Westinghouse Electric & Manufacturing Company

The City Electric Co. exhibited a model underground vault which was equipped with two 11,000-volt combined switch and fuse boxes, and a 500-volt, three-wire, large capacity, six-way junction box made by the company, and a General Electric, type H, 100-kw., oil-cooled transformer. This concrete vault is typical of the company's manholes throughout the city and impressed the visitors with the absolute care necessary in underground power transmission.

The City Electric Co.

Motors.

The most elaborate exhibit of motors was that of the industrial and power department of the **Westinghouse Electric & Mfg. Co.**, which featured vacuum cleaners, ice cream freezers, buffers, grinders, polishers, sewing machines, drilling machines, meat choppers, and fans, all driven by Westinghouse motors. They also exhibited a miniature oil well derrick showing the operation of drilling, pulling and pumping oil in the California fields. A complete line of every type of motor manufactured by this company was represented.

The General Electric Co. exhibited a large number of induction motors and exemplified their application to sewing machines, buffing machines and to their new breast drill. They exhibited their auto-control for both direct and alternating current and a number of starting compensators.

The Fort Wayne Electric Works had on display a large number of special and standard power motors ranging from 1/100 to 1/4 horsepower. They also showed a Giles type E automatic steam engine connecting with a Fort Wayne generator and the Paul system of air compressing and pumping.

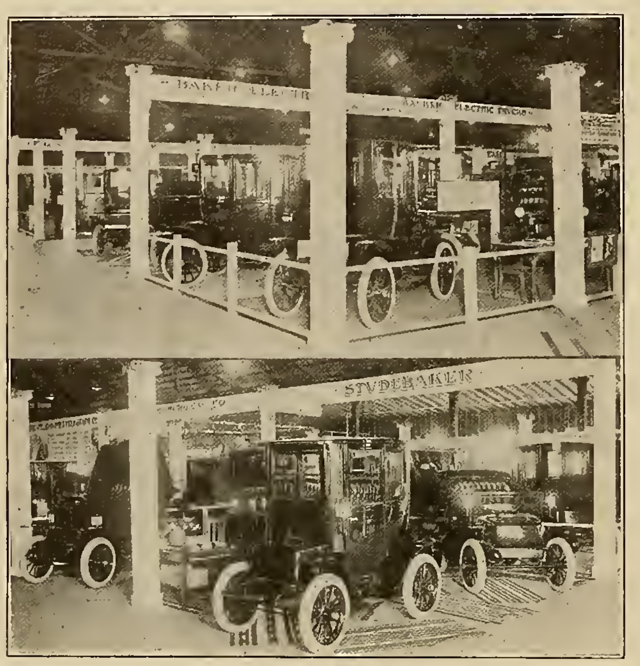
The Century Electric Company of St. Louis exhibited a number of single phase Century motors ranging from ¼ to 5 horsepower.

Parrott & Co. had an interesting exhibit of Kimble alternating motors, one of these driving a Chandler-Price printing press. A number of small motor applications were shown, including a motor driven fan. Crocker-Wheeler motors, generators and dynamos of all types were exhibited by **Chas. L. Kiewert & Co.**

Chas. L. Kiewert & Co.

Electric Vehicles.

Perhaps the most ambitious of all classes of exhibits were the electric automobiles, it being believed that such a large number of different makes were never before assembled at an electrical show. **R. B. Daggett & Co.** showed three Baker electrics and a Walker electric truck in addition to a number of demonstrating cars. The **Studebaker Co.** exhibited four vehicles, the **Columbus Electric** two, a roadster and coupe, there also being a runabout and stanhope for demonstrating; the **Detroit** two coupes equipped with Edison storage batteries; Rauch & Lang, represented by **G. A. McDougald & Co.**, a coupe; the **Babcock** one car, and the **Ideal** four passenger electric coupes. The storage batteries of these were supplied with direct current either by means of a motor generator set or by mercury arc rectifiers.



Electric Vehicles

The Electric Storage Battery Co. exhibited a full set of storage battery trays showing the "Exide" battery as furnished for the various vehicle manufacturers, the names appearing on the trays. In connection with this exhibit there was also a full line of "Exide" vehicle battery parts. The "Exide" sparking battery for gasoline engine ignition was shown complete and in section, together with a full line of parts. The Electric Storage Battery Co. also exhibited a low voltage tungsten lighting outfit, recently developed for use in farm houses and country residences. The outfit consists of a gasoline engine providing a small 40-volt d. c. generator, a storage battery of 16 cells of the "Chloride Accumulator" with three counter cells for regulation and complete switchboard with ammeter, voltmeter, rheostat, circuit-breaker and circuit switches. The current from the set was used to supply about fifty 8 and 16-candlepower, 32-volt tungsten lamps.

Hughson & Merton exhibited the Connecticut system of ignition for automobiles, the Jones electric automobile horn, the Jones live map and the Jones speedometer, this exhibit being in charge of H. W.

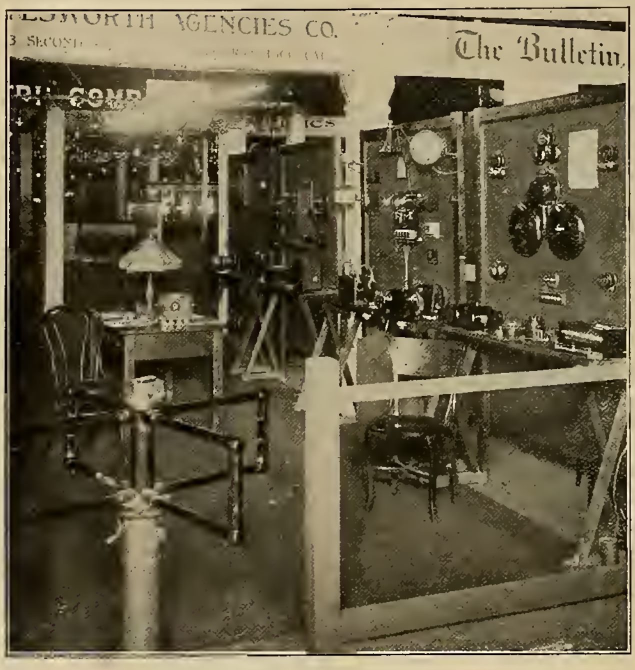
American Ever Ready Co.

Coffer, the factory representative. The **Aylsworth Agencies Co.** exhibited the Apple Electric Co.'s automobile light and ignition system.

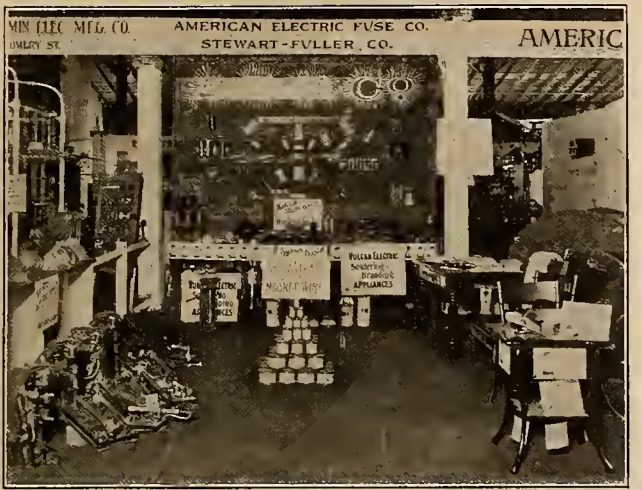
The American Ever Ready Co. exhibited a line of novelties and dry batteries of general interest to automobilists. These included electric flashlights, sparking plugs, speedometers, automatic automobile starters, wind shields, tire chains and automobile accessories. The "Eveready" battery for ignition purposes and the "Three Crescent" telephone battery, manufactured only in San Francisco, were also exhibited, together with a large number of vacuum bottle and electric novelties.

Switchboards and Instruments.

Otis & Squires, representing the H. Krantz Mfg. Co., the Cutler Hammer Co., Columbia Incandescent Lamp Co., L. B. Allen Co., Dossert & Co., American Conduit Mfg. Co., Knoblock-Heideman Mfg. Co., Mathias Klein & Sons Co., Machado & Roller, Paragon Sellers Mfg. Co. Van Nort Brush Co. exhibited a complete line of switchboards, panel boxes, switches



Aylesworth Agencies Co.



American Electric Fuse Co.

and high tension apparatus. These included a two-panel Krantz switchboard, Krantz knife switches, Cutler-Hammer push button, specialties, magnets and controlling apparatus, Roller-Smith instruments, Klein's linemen's tools, Paragon ground cones, Blackburn ground clamps, Paragon self-tying knobs, Ironite drop wires and Dossert connectors.

The Electric Railway & Mfrs. Supply Co. exhibited a seven panel board of their own manufacture. This board was equipped with Trumbull fuses, Westinghouse voltmeters and ammeters, Duncan wattmeters and Trumbull switches.

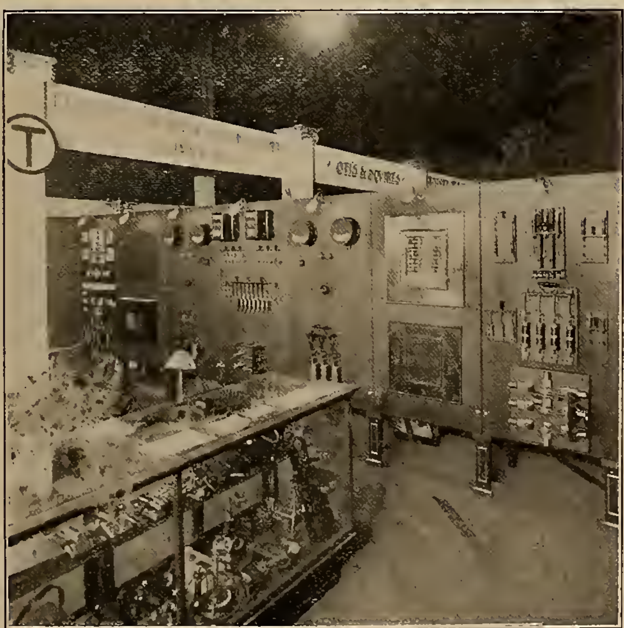
The Drendell Electric and Mfg. Co. of San Francisco exhibited a number of switchboards recently made for their customers, including a three panel board to be delivered to the Decker Electric Co. for the Cuoyaga Rubber Co. of Mexico, a three panel board for the Central Electric Co. at Fort Whipple, Arizona, and a panel box for the Pacific States Electric Co.'s Alcatraz Island contract. They also showed a number of copper connectors and remote control switches.

Frank E. Smith

The Westinghouse Electric & Mfg. Co. through their detail and supply department showed a complete line of transformers and line circuit breakers, switches and kindred devices.

The General Electric Co. exhibited a direct and alternating current switchboard in connection with a mercury arc reflector which supplied current for stereopticon views showing a number of lantern slides illustrating their heating appliances. Testing instruments were also exhibited by the General Electric Co., Westinghouse Electric & Mfg. Co. and Otis & Squires.

Frank E. Smith, representing the **Weston Electrical Instrument Co.**, showed for the first time the new Weston switchboard wattmeters, both single and polyphase, synchroscopes, power factor meters and frequency indicators, all of which were in operation on the main leads supplying the exposition with light and



Electric Railway & Manufacturers Supply Co.

Pacific Electric & Mfg. Co.

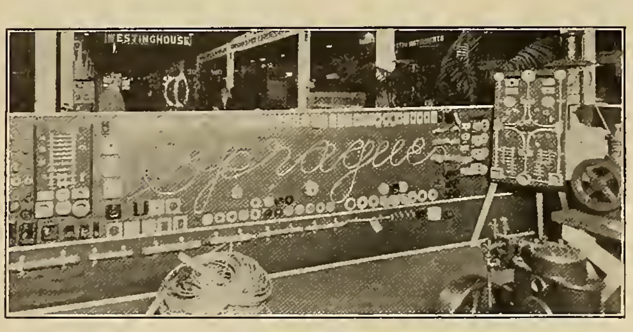
power. Besides these a full line of regular switchboard and portable instruments were shown.

The Pacific Electric & Mfg. Co. exhibited an oil switch with electric control for 80,000 volt service and a pole top switch for high tension power lines. A number of disconnecting switches for lower voltages, together with the Wooll motor protecting switches were also exhibited.

The American Electric Fuse Co. displayed the Allen-Bradley line of alternating and direct current rheostats with indestructable resistance, Muskegon spark coils for marine and gas engine use, black enamelled magnet wire and wireless coils and telephone protective equipment. In the same booth the Steuart Fuller Co. demonstrated Vulcan electric soldering and curling irons and displayed Pierce drills.

Wires and Cables.

The American Steel & Wire Co. had an elaborate exhibit of all the different kinds of wires and cables carried in stock on their San Francisco warehouse. These included copper and iron wire, bare and insulated of all sizes and for all purposes, from a magnet wire to a million circular mil cable. They also showed a complete exhibit of rail bonds and pole steps.



Sprague Electric Co.

The Sprague Electric Co. had a complete exhibit of conduit conductors, air and steam armored hose, all of particular interest to contractors.

Standard Underground Cable Co.

The Standard Underground Cable Co.'s exhibit consisted of coils and reels, bare and insulated copper wire, lead covered cables, bare and insulated copper clad wire, armored terminals, insulating tape and compound and cable accessories. Many people were interested in a sample of the submarine cable used by the Bay Cities Home Telephone Co. across San Francisco Bay.

The National India Rubber Co. exhibited boards showing samples of cable cords, wires and cables, and railway signal wire.

Vacuum Cleaners.

Electric vacuum cleaners of all sizes and shapes were greatly in evidence and attracted much attention. These included the Duntley, Hoover, Little Giant suction sweeper, the Keller-Santo and the Monarch.

Miscellaneous.

The Reed Electric Works of Mayfield, California, demonstrated their electric welding machine.

The H. W. Johns-Manville Co. displayed their "Noark" service subway boxes, "Noark" enclosed fuse material, J-M dry batteries, fibre conduit and fittings, asbestos roofing, insulating materials and fittings, in addition to the J-M Linolite system of electric lighting. Some good examples of electric sign or weatherproof

H. W. Johns-Manville Co.

J-M Linolite lamps were exhibited, also type "B" window reflectors and some new corrugated glass type "E" reflectors. J-M Linolite desk and table lamps and some special silver-plated reflectors for picture lighting were also shown. J-M porcelain insulators which are made for all classes of service up to as high as 100,000 volts were represented by a complete line. These insulators are now made in both petticoat and disc types together with pins, fittings, etc., for long distance transmissions and other systems.

Overhead material was shown in quite a variety of products among which may be mentioned the "Giant" strain insulator. J-M friction-tapes and sylicing compounds were well shown. the tape in six brands, which makes a permanent water-tight, high grade insulating compound was represented by two brands. The H. W. Johns-Manville Company make a great variety of insulating materials for various kinds of apparatus, such as arc deflectors for controllers, special plugs for heating and cooking devices, electrobestos shapes and samples and moulded mica weatherproof lamp sockets, which are so extensively used in parks and out-of-doors decoration, in paper mills, breweries, laundries, anywhere in fact where acid fumes or moisture is present.

Brook-Follis & Co., one of the few jobbers who exhibited had an interesting display of all kinds of electric apparatus, including electric . poles, sockets, switches push buttons, lamps and telephone apparatus, and vibrators.

The Southern Pacific Company, occupying one of the large central spaces, had a working model of their automatic block system, together with two full sized block towers, stereopticon views of the Missions of California and distributed a general line of literature.

The Walters Surgical Instrument Co. exhibited a complete and interesting line of X-ray apparatus, Crooks tubes, electro static apparatus, medical coils and therapeutic lamps and appliances.

The Paraffine Paint Co. had an exhibit of insulating tape and compounds, Malthoid roofing, building paper, deadening felt, etc.

A number of electric vibrators, including the Golden, the Universal and the Arnold were exhibited by various companies.

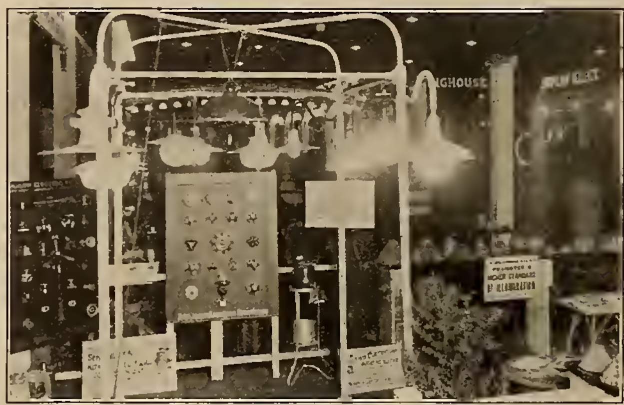
John R. Cole & Co. exhibited Bossert conduit knockout boxes, covers, bushings; Chase-Shawmut Co., circuit breakers, enclosed fuses, cutouts, Electric Railway Equipment Co.'s overhead line material; Hubbell pull sockets, flush plugs, guards, shades; W. N.

John R. Cole Co.

Mathews & Bro.'s guy anchors, lamp guards, splicing joints; the New York Insulated Wire Co.'s rubber covered wires for telephone, light and power; the Stanley-Patterson "Faraday" bells, waterproof floor boxes and wireless batteries.

The Benjamin Electric Manufacturing Co. of Chicago had a particularly attractive and well arranged exhibit. Their exhibit, in the main, consisted of a large white enameled frame in the form of a crossed arch. On these arches were arranged the many types of Mazda and other forms of fixtures which this firm gets out. Among the most advanced types was the new street series socket which caused considerable favorable comment, due to its simplicity and exceptionally neat and strong appearance. A Cargo light of heavy spun copper and galvanized steel guard was also displayed. A complete line of their new reflector sockets was shown, and created much interest owing to their adaptability to industrial lighting, which is receiving so much attention at this time from illuminating engineers. Two handsome sample boards were arranged at the rear of the arches, on which were mounted a complete line of the Benjamin Electric Manufacturing Co.'s wireless clusters and other lighting appliances.

The Holophane Co. had an attractive booth, in which was shown a complete line of globes and reflectors manufactured by that company, and particularly the new "Stiletto" prism type reflectors. The



Holophane and Benjamin Electric Mfg. Companies.

booth was tastily arranged, offering a restful place for the many out-of-town customers who visited the exhibit. The certer piece of the general illumination of the Coliseum was a large Holophane sphere in which were colored lamps.

Kohler & Chase had a complete line of automatic pianos, a number of which were motor driven, including a large Wurtlitzer organ which furnished music for the Exposition.

Holabird-Reynolds, in addition to the "Hot Point" and Franklin and Mazda lamps already described, had a complete exhibit of Ohio Brass insulators.

The Electrical Contractors' Association had a comfortable reception room and exhibited some of their work. Power was supplied from a 5 kw. Westinghouse generator driven by an 8 h.p. Union gas engine to operate a number of tungsten and carbon lamps arranged to spell "Modern Wiring Methods." A glass switchboard made for the contractors by the Jupiter Switchboard Co. of San Francisco and also one made for the Pacific Fire Extinguisher Co. were on display.

The Burroughs Adding Machine Co. had an interesting display of motor driven adding machines.

The Electrical World, the Electrical Review and Western Electrician, and the **Journal of Electricity, Power and Gas** had reception booths, the Electrical Review being represented by its managing editor, Mr. A. A. Gray.

COLORADO ELECTRIC POWER & RAILWAY ASSOCIATION.

The eighth annual convention of the Colorado Electric Power and Railway Association was held September 21-22 at the Hotel Colorado, at Glenwood Springs, Colorado. The association was well represented, about seventy-five members being present.

The meeting was called to order by President W. T. Wallace at 2 p. m., Wednesday, September 21st, who made a short address; Mr. Howard L. Aller of the General Electric Company of Denver, read a paper on the Mazda Series Street Lighting, which was well received. An interesting discussion followed. After a paper on Motors, the question box was taken up, a great deal of interest being taken. The meeting was then adjourned to convene on Thursday, 10 a. m. The convention opened with a paper read by J. M. Connelly of Denver on "Cultivating Friendly Relations With the Public," followed by a lively discussion. The next paper read was by J. C. Lawler of Colorado Springs on "Distributing Pole Lines." This was also an interesting paper was under discussion. This concluded the morning session.

The afternoon session was called at 2 p. m. and was a short one. A paper on the "Creosote Treatment of Our Native Lodgepole Pine Pole" was read by Geo. R. Ogier of Denver. After a short discussion the meeting adjourned to witness a baseball game between the Electric Club and the Association team. The Association were the winners, the score being 13 to 6. During the game the Sons of Jove sold peanuts, chewing gum, cigars and soda-pop.

In the evening an executive session was held.

The Friday morning meeting convened at 10 a. m. and was opened by an interesting paper, read by A. L. Jones of Denver on "Rotary Condensers, Induction Generators on Transmission Systems." This was followed by the report of the committee on grounding secondaries, read by J. A. Clay, chairman of the committee. Quite a lengthy discussion followed the reading of the paper. The meeting then adjourned.

The afternoon session, called at 2 p. m., was opened with a paper read by E. M. Gilbert on "Steam Turbines." After the discussion of this paper, the question box was taken up. General business followed the question box. Under this head it was suggested that all papers to be read before the convention should be prepared at least two weeks before the convention convened so as to give members time to prepare themselves and become familiar with the subject.

In the secretary's report it was shown that there were 52 active and 55 associate members, a gain of two members over last year. The new officers for the ensuing year were next elected: President, H. L. Corbett of the United Hyroelectric Co., of Georgetown, Colo.; vice-president, J. A. Clay of the Animas Water & Power Co., of Silverton, Colo.; secretary and treasurer, F. D. Morris of Colorado Springs; executive committee, W. T. Wallace of Canyon City, J. F. Dostel of Denver, G. B. Tripp of Colorado Springs; advisory committee, J. J. Cooper, A. L. West, C. H. Williams and J. A. Beeches; membership committee, B. S. Manual, S. B. Bechey and H. L. Allen.

Papers read will be published in the "Journal" during the next few issues.

PACIFIC COAST GAS ASSOCIATION.

The Eighteenth Annual Convention of the Association which adjourned Wednesday evening, September 21st at one of the most sumptuous banquets ever given by it, has been voted the most successful ever held by the Association.

There were sixty-six active and seventeen associate members at this convention and one hundred and fifty members in attendance.

Officers and directors for ensuing year are: President, Frank A. Leach, Jr., Oakland; vice-president, Wm. Baurhyte, Los Angeles; secretary and treasurer, John A. Britton, San Francisco; assistant secretary and treasurer, Henry Bostwick, San Francisco. Directors: H. E. Adams, Stockton; H. W. Burkhart, Los Angeles; E. C. Jones, San Francisco; Joseph M. Berkley, Los Angeles. Editors and Committees: Wrinkle editor, F. C. Millard, Los Angeles, Cal.; experience editor, John D. Kuster, San Jose, Cal.; novelty editor, John Clements, Oakland, Cal.; librarian, E. C. Jones, San Francisco, Cal. Committee on Gas: Engineers' degree, E. C. Jones, L. P. Lowe, John A. Britton; advisory board, Sherwood Grover, W. J. Dorr, Frank Foveaux.

The next meeting will be held at Oakland during September, 1911.

An interesting exhibit of gas appliances was held at the skating rink, West Sixth street, open to the public the entire week; this proved to be a great attraction and deserves no little praise for its attractive appearance.

The companies exhibiting were: The Buck's Stove Company, the Welsbach Company, Trenkamp Stove and Manufacturing Company, the Economic Gas Appliance Company, the Patriot Jewel Stove Works, the Humphrey Water Heater Company, Lawrence & Co., the Ruud Manufacturing Company, the Sprague Meter Company, the Pittsburgh Water Heater Company, the Pure-Air Range and Grate Company, Perfection Gas Furnace Company, the W. M. Crane Company, George M. Clark & Co., the Capell Sales Company, the Reznor Manufacturing Company, the Hammer-Bray Company, Van E. Britton and the Eclipse Gas Stove Company.

Examinations for steam engineers, first and second class, are announced by the United States Civil Service Commission, on October 19, 1910, to fill vacancies as they may occur in the departmental service at Washington, D. C. The examination will consist of letter writing, practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first-class public buildings), and training and experience in mechanical and electrical engineering.

Examination for electrician's helper is announced by the United States Civil Service Commission, on October 19, 1910, to fill vacancies as they may occur in any branch of the service in the position of electrician's helper. The usual entrance salary is $600 per annum.

THE PREVENTION OF ACCIDENTS.[1]

BY JOHN P. COGHLAN.

The introduction of machinery brought many new risks and hazards into all modern employments. At first the tendency was to consider the additional accidents which followed new appliances as mere incidents to improved methods and increased production. But time proved this to be a false view. It showed that while every effort was made to make more and better machinery, little or nothing was done to insure safety in operation. Moreover, it demonstrated that additional accidents meant an extra outlay of capital in repairs and in damages for killed and injured workmen, and, often, a loss in production, in that each accident affected the temper and spirit of workmen, and thus reduced their interest and efficiency.

Once these conditions became manifest, employers in many industries set about to correct them. At first the effort was to prevent a repetition of accidents that had already occurred, and to that end faults and defects that had produced injury were corrected and repaired. In other words, accidents had to occur before defects were seen and remedied. But eventually, it was found that accidents could be foreseen. This discovery naturally led to a study of operating conditions and finally to a detailed inspection intended to prevent accidents. Wherever inspection was taken up systematically it soon developed into well organized safety departments; so well, in fact, that today many industrial corporations maintain safety superintendents equal in rank to other heads of departments. These superintendents generally head an organized office force and a corps of trained inspectors. Usually their inspectors are experts in the operation of machinery and oftentimes in complicated methods of manufacture. Not infrequently, they are specialists in the manufacture and operation of one particular class of machinery.

These inspectors devote all their time to studying the causes of accidents and the means of preventing them. They carry on a detailed inspection, reporting every defect. Often they report to their superintendent daily, frequently illustrating their work with photographs. In their reports they embody suggestions from foremen and superintendents, and often from workmen. And in all cases they accompany their reports with recommendations showing how and where defects in operation may be remedied.

In some corporations the recommendations of such inspectors are submitted by the safety superintendents to a board or committee. Usually this board or committee is made up of the superintendent himself, and two or four of his assistants. Sometimes it is composed of the superintendent, the casualty manager and an engineer.

In many corporations every accident is investigated by a committee specially appointed for that purpose. Oftentimes the committee is composed of foremen and superintendents; at other times of workmen taken from the department in which the accident under investigation occurred. In every instance the committee is authorized to make a complete investition and to report how to avoid like accidents. Wherever a corporation has had the foresight to appoint either of these committees it usually has been progressive enough to adopt the recommendations submitted to it.

The United States Steel Corporation has maintained a permanent committee on the prevention of accidents since April 1st, 1908. This committee is composed of five members selected from the most prominent casualty managers of the constituent companies. It employs a full corps of inspectors and considers some two hundred recommendations a month. In the first year of its existence it put into effect over two thousand improvements suggested by its inspectors.

In some of the subsidiary companies of the Steel Corporation, two committees on accidents are permanently maintained in each mill or plant. One of these is called "the foreman's committee"; the other "the workmen's committee."

The foremen's committee is generally composed of the plant superintendent, his chief mechanic and a department foreman or two. Some of the members are kept on the committee permanently, but the foremen are changed from time to time in order to give experience to the greatest number. Each month the committee makes a complete inspection of the plant. It not only examines machinery, but every detail of the plant, even to floors and stairways, and makes a report recommending such changes and improvements as may tend to prevent accidents. Should an accident occur during the month, the committee makes it the subject of a special investigation and a special report.

The workmen's committee is kept separate and distinct from the foremen's committee, and is made up of workmen exclusively. One month it may be composed of a machinist, an electrician and a carpenter, another of an engineer, a pipe fitter and a wireman, and so on until every man in the plant has had a term of service. The members of the committee are selected by the plant superintendent in consultation with his foremen. Each serves a month. The committee makes one inspection a week and reports in writing the result of its labors. As each member retires from the committee he is asked to continue his interest in the work and to report to succeeding committees anything conducive to his safety or to the safety of his fellow employes. In this way attention is held indefinitely, often to the extent that members of early committees go on making suggestions months after their terms of service have expired.

In some plants it has been found advisable, apart from these committees, to employ special inspectors for certain kinds of machinery, such as cranes, engines and elevators. Usually, such inspectors have expert technical training and are required to make complete reports upon the machinery examined. They have power to shut down any machinery found defective or dangerous.

Wherever safety committees have been appointed the effect has been beneficial. It has been found that

[1] Paper read at the eighteenth annual convention of the Pacific Coast Gas Association, September 21-24, 1910.

the workmen take a new interest in safety appliances; that they find them useful and make efforts to keep them in place, whereas, before, they opposed safeguards and did little to keep them up; and that they suggest repairs and protection devices which would often escape an outside inspector.

Furthermore, experience has shown that these inspections have a moral value in that they serve to stimulate those who have the care of machinery to greater caution and more careful operation. The knowledge that defects once found will be reported once a week until repaired, keep men on their mettle and cause them to see that repairs are promptly made.

As a result of recommendations made by inspectors and safety committees in the steel corporation, stairways have been built to all overhead steam valves and connections, so that such valves and connections may be quickly reached and safely worked upon. All walks along which it is necessary to travel for the inspection or repair of steam pipes have been provided with handrails, and every stairway and walk has been specially lighted. Ladders for reaching pipes or connections of any kind have been entirely abandoned.

Danger from exploding gauge glasses has been eliminated by using a guard made of sheet metal which can be turned in front of the glass when anyone is working about it, and at other times swung back so as not to shut off the view of the register.

"Non-return valves" have been placed in all boilers and steam pipes, and so fitted as to close automatically in case of a break of any kind, thus bringing the system under control without the risk of closing the valves by hand.

In one plant of the Steel Corporation an inspector checking up accidents found that injuries frequently happened to men engaged in repairing boilers, through wrong valves being turned and steam admitted to the boilers. Examination showed him that these occurrences resulted from mistakes in identifying a particular valve which was often one of a great number in a long row, all exactly alike. To guard against such mistakes thereafter he caused these valves to be numbered, and red warning signs marked: "Danger—Do not Remove," to be hung on them when anyone was in a particular boiler. Whenever practicable, he made it the duty of the men doing the work to place these warning signs.

Many mills now have engines equipped with an attachment to stop them in case the governor breaks or becomes ineffective. Others have all their large engines equipped with automatic stop valves with speed limit attachments. These are intended to shut the engines down automatically when they exceed a certain safe speed. In one mill of the Steel Corporation there are push buttons in various prominent places, by which any engine can be instantly shut down. Each of these buttons is marked with a blue light which is never allowed to go out. If a man is caught in the machinery or a breakdown occurs, one of these buttons can be pushed and the machinery instantly stopped. Nearly one hundred of these stops have been installed in this particular mill.

These buttons operate by electricity, and, to insure that they are always in order, they are used each day to start the engines. Furthermore, it is required that each button be pushed once a week with a man at the engine throttle to see that it works properly. In this same mill "butterfly" valves (valves which close instantly by pulling a lever) have been installed as an additional protection. Chains or wire ropes are carried from the valve lever to convenient points so that the engines can be stopped from almost any part of the mill. Similar appliances have been adopted in this and other mills to stop electric motors, which are also operated by electric buttons placed at prominent points in the mill, and always accessible. Ropes, too, are often extended from the machinery operated by such motors to switches which can be pulled in emergency and the machinery immediately stopped. In one mill it is reported that a workman's hand had been caught in a roller, and that on his crying out, several fellow operators pulled the rope together, and so quickly that the switch was torn from the wall, and the motor instantly reversed, with the result that only the tips of the man's fingers were caught, whereas, without the rope his whole hand would probably have been mangled.

In the mills of the American Steel and Wire Company inspectors discovered some years ago that many of the most serious accidents occurred in the operation of cranes. They made a number of recommendations which were immediately put into effect. Later, an order was issued from the management that all specifications for new cranes should provide for all known safeguards. Among others, there were specified:

A foot walk on the side of the crane with a toe board along the edge; covering for all exposed gears; limit switches to prevent loads being lifted too high and breaking away from the drum of the crane; a safety switch on the upper part of the bridge, by which a workman could prevent anyone starting the crane from the cab while he was at work; for safety couplings, breaks and bumpers; a gong by which the operator could warn anyone underneath of the approach of the crane; and, finally, a brush or prong to move along in front of the crane wheels and push aside a hand or a foot resting on the rail of the runway before it could be caught or crushed by the wheels.

It is said that the first day a crane was fitted with the prong attachment, a workman, who was working with one leg across the crane track, was thrown aside and his leg saved from being crushed by the wheels. On another occasion a lineman who was supporting himself by placing one arm around the track was shoved away by the prong, and, though he fell ten feet to the floor, was saved from serious injury. Without the prong his arm would have been cut off near the elbow.

Other precautions which have been taken as the result of reports of safety inspectors and committees, are these: Projecting set screws have been entirely eliminated. Screws on lathes and other machinery have been covered or boxed in. Cans have been provided with light spouts 10 to 12 feet long for oiling machinery, in order that the oilers may not be com-

pelled to go into dangerous places. Rails have been furnished for all walks along lines of shafting. Handrails have been provided for all scaffolds for painters and riggers. A painters' chair with a safety belt has been adopted, so that if the man using it were to fall out of his seat, the belt would hold him. Counter weights have been boxed in so that they cannot fall on anyone in case the attached rope or chain breaks. Covers have been made for emery wheels so that if the wheels break the pieces cannot fly off and do damage.

When specifications are sent from the mills of the Steel Corporation for new machinery or for building new appliances, they are checked up to see that the latest safety provisions are included. In most instances the contracts which accompany the specifications contain this provision:

"Safeguarding of gears, planers, couplings, collars, set screws, etc., will be covered as fully as possible in the drawings which are furnished. But it is understood that these things shall be subject to the approval of our inspectors who shall have free access at all times to the machinery while it is in process of construction and erection."

Other corporations cause to be printed on the stationery of their purchasing departments this motto:

Provisions for safeguarding workmen should be brought to our attention as we will consider them in selecting new machinery and equipment."

Often in big enterprises an effort is made to impress upon the workmen the necessity for using care. Instructions are printed on their pay envelopes that they must be careful of themselves and of their fellows. Similar instructions are also frequently stamped on time sheets and requests for material.

Some of these instructions are:

"Always be careful and take no risks.

"You are responsible for the safety of others as well as yourself.

"Carelessness as to the safety of yourself or others will be sufficient cause for dismissal."

Another result of inspection has been the more frequent placing of warning signs around dangerous machinery. For instance, in many mills of the Steel Corporation notices are posted at ladders or runways leading to cranes, instructing workmen to notify the crane operator before doing any work on the crane; over valves, switches and control levers, to guard against their being started while men are working where they may be injured; over elevators to show when they are in operation and when they are not; and over electric switch boards (often in five or six languages) to show the voltage and whether the current is on or off.

The steps taken by the corporations I have referred to suggest what can be done along similar lines in other industries. Some system of inspection can be established even in the smallest plant, and where workmen are employed in any numbers safety committees can be organized with good results. Even the most limited inspection will prove profitable. It will bring inquiry and investigation, and wherever either is found, there also will be found reform and a striving for better things.

FIRE INSURANCE AND FIRE PROTECTION AS APPLIED TO THE GAS AND ELECTRIC BUSINESS.[1]

BY R. J. CANTRELL.

Why we cannot afford any more, or as well, as other lines of business to be included among the industries throughout the United States that annually contribute to the $215,084,709.00, or an annual per capita fire loss of $2.51, as against 33 cents per capita loss in Europe.

In the first place no gas or electric company operating under the most favorable conditions, can afford to allow its properties, and especially its producing plants, to be consumed by fire.

Secondly: We cannot afford to lose the revenue incidental to losses by fire.

Thirdly: We cannot afford the natural criticism and loss of prestige on account of resultant poor service or the wiping out of years of labor in advertising and building up a reputation for good and continuous service.

We all know it is becoming the habit among the fire departments and newspapers throughout the country, when a fire is discovered, and of which there is no positive proof as to the origin, to credit such fire to "crossed wires," whatever that may mean to the reporter who writes the article. It is an easy way to account for a fire and at the same time there are so many other causes, that it behooves the gas and electric companies themselves, to use every precaution toward eliminating electric wire fires, not only in their own properties, but throughout the cities wherein they operate. The stigma which attaches to gas and electric companies through criticism on account of fires should not exist. It hurts us with the public; it is an argument often used by unscrupulous salesmen for oil, gasoline and kindred appliances, and the gas and electric companies themselves should use every endeavor to remove this condition.

Following this line of thought, if a fire occurs in any city and is credited to the negligence of the gas or electric company, it is a condition over which we have very little control, but on the other hand, if a fire occurs in the plant or on the properties of any gas or electric company, or through the carelessness of our own employes, the criticism is often more severe and our responsibility is increased many-fold, for such a condition should not exist and the causes making such a fire possible, should be removed.

Precautionary Measures.

Cleanliness: Cleanliness is an element to this end. "Cleanliness" covers a multitude of virtues and it removes a multitude of sins. In years gone by there seemed to be a prevailing sentiment that a gas works, and also an electric station—in a lesser degree, should be a place for the accumulation of dirt of various degrees of blackness; that a gas maker would not be healthy or strong if not begrimed from head to foot with lampblack, coal tar, etc., and that an operator in a station should be involved in a certain coating of machine grease; should have a piece of oily waste hanging from his hip pocket and take on a general aspect of a coal heaver—this condition going to prove

[1]Poper read at Eighteenth Annual Convention Pacific Coast Gas Association, Los Angeles, September 21-24, 1910.

conclusively to visiting engineers and officials of the company that such men are hard and tireless workers; as indicated by the dirt in which they had been wallowing.

These conditions, however, have changed and there are at the present time in certain gas works under our supervision, not to mention the electric stations, men who have proven conclusively that a gas works can be kept as clean as any other factory, and even clean, white-washed walls are becoming common throughout our properties.

Cleanliness as above mentioned has a wide scope and should embrace the removal of every item of refuse and unnecessary material from our plants to a safe distance. Old overalls and wearing apparel of all kinds should be discarded and removed entirely from the premises when they have served their usefulness, and not hung behind doors, thrown under benches, etc., and oily waste is one of the most dangerous elements existing and proper cans should be provided for the caring of discarded waste, and also new waste.

Window Glass: Window glass which is broken should be repaired at once, and not left as an opening for live sparks and drafts to communicate fires to out buildings.

Hose Lines: Hose lines should be installed of the best quality of rubber-lined mill hose, with suitable nozzles, and such hose lines should be kept connected at all times, and not used for any other purpose than for fire protection.

Leaky valves and the rotting off of hose lines at valve connections, which is of common occurrence, is avoided by installing drip cocks between the valve and the hose connection, or boring a ⅛-in. hole in the lowest point in the valve or in the connection, outside of the valve, so as to allow any water which may leak through the valve to drip off, and not run down and enter the hose and cause a rot.

Hose reels are becoming more or less obsolete as instanced by their being discarded by fire departments, and the adoption of hose wagons from which the hose can be readily dragged.

Hose houses for outside, weather-exposed places, are preferable with a shelf in such houses made of slats, the hose to be piled on the shelf and which allows of the hose being connected to the valve at all times and given plenty of ventilation to guard against sweating and dry rot, which can happen when a hose is wound tightly on a reel. A plain shelf inside of a building will answer the purpose of a hose receptacle better than a reel.

A common fault is the installation of hose lines of a size too large and longer than can be properly handled by one or two men, and especially where it is necessary to use a hose on a gallery or on a roof. The National Fire Protection Association will not endorse a hose line for one man, larger than 1½ in., as a larger size is considered too heavy for the watchman or one man to handle.

Where city water pressure is not sufficient a pump should be tied into the water system, such pump to be installed on a line by itself, and not jumbled up on different pipe lines feeding water to boilers, scrubbers, or other machinery in the plant.

Electric motor-driven pumps are not recommended for fire purposes, on account of the possibility of the electric current being "cut out" at the time of fire.

Ladders: No plant should be without a ladder for free access to the roofs and our rules provide for stationary ladders, attached to walls of buildings having wooden roofs, insuring their being there when needed, and not down in the corner of the yard under a pile of lumber.

Fire Extinguishers: These are invaluable when properly cared for and regularly examined, cleaned and re-charged. Electric stations are best served with powder extinguishers for fires in large machinery; sand, thrown from buckets on machinery and open switchboard work. Secondly, and in time of dire necessity after the current has been cut off, chemical extinguishers and hose lines should be brought into play.

Wet generator armatures or field coils are of more value than a machine entirely burned out.

Oil fires are best taken care of by sand and chemical extinguishers.

Sand Buckets: Fibre sand buckets only should be used in electric stations; metal buckets being dangerous on account of possible contact.

A rule established by the Pacific Gas & Electric Company, as to the methods of caring for electric fires, calls for the use of dry powder extinguishers first; throw sand on open switchboard, oil and wire fires where the fire can be readily attacked, and where smothering is the main object.

Chemical extinguishers (contrary to the general ideas on this subject) can safely be used (after the current has been cut off from a motor or generator) without harmful effect to such apparatus, it being conceded that a wet machine is better than a machine entirely destroyed by fire. When a chemical extinguisher has been used on a machine, the machine or parts thus dampened should, of course, be taken out and immediately dried.

One of the most careless and wasteful expenditures of money in connection with chemical extinguishers is the purchase of same and the common practice of neglect in their up-keep and re-charging at stated intervals. A system adopted by the Pacific Gas & Electric Company calls for the re-charging of all chemical extinguishers once every six months, and a check system against neglect so to do, consists of a small metal case tacked to the wall alongside of each extinguisher, such case containing a number of cards, with a duplicate stub to each card, and these cards are to be filled in every six months and the stub sent to the general office, showing the date of re-charging. These stubs are filed away, six months hence from the time of last re-charge, and a new stub must be sent in each six months to replace the last one received. Each extinguisher is given an individual tag number. Special attention should be given to the selection of chemical fire extinguishers, there being a number on the market that must be considered dangerous from possible explosions, and others that are defective and worthless.

Three-gallon chemical extinguishers are recommended—larger sizes being too heavy and unwieldy for ready use.

It seems to be a common error that fire fighting apparatus, especially in electric stations, should be crowded onto and behind switchboards, and in dangerous places where a fire is most likely to occur. Fire apparatus should be placed in the open, on columns in the center of the room, or on a wall well removed from the danger point; the object being to allow men to get at the apparatus easily and quickly and then fight their way to a fire, rather than go into a fire empty-handed and grope around for the fire apparatus best adapted to kill such fire.

Fire apparatus should also be installed in stipulated places to be decided upon as a "fire station," and kept in such places in order that men may know where to find it in case of fire, and not have to look behind doors and under benches for fire appliances when urgently needed and needed at once.

Watchman's Clocks: Where plants are sufficiently large to warrant a night watchman, watchman's clocks should be used.

Gasoline assumes the elements of a paradox. To the gas and electric men having to do with the commercial end it is always a bugbear—a threat under which to drive a hard bargain before a contract for power or lighting can be closed, and a continual source of annoyance.

To the gas men out on trouble of a certain nature, it means relief—a helping hand and a freer flow of gas.

To the insurance department it is a nightmare. it is on a par with the Prohibitionists' "Demon Rum"; it is a menace to property, to life and limb, and its mere presence means higher rates of insurance and continuous surveillance and inspection of properties.

Do not keep gasoline in your buildings; store it in the yard, and only draw it in the necessary small quantities desired. A book could be written on this subject and it would be long and horrible.

Matches.

Safety matches only should be purchased and allowed employes.

Inspections.

Money spent in inspecting properties and caring for fire apparatus is well spent, but such inspections should be systematic, at stated intervals, and not haphazard, as time flies and apparatus may be useless when urgently needed.

Why Gas and Electric Companies Can Safely Carry Their Own Insurance.

Gas and electric plants are almost constantly guarded, being, in most cases, operated continuously.

A sufficient water supply can always be had and proper hose lines installed if given the necessary attention.

The buildings of a gas plant are a secondary consideration, and their loss by fire does not necessarily mean the shutting down of the plant. Gas plant buildings should be so erected that they will not cause unnecessary damage to the machinery in case the buildings burn.

With proper precautions there is no excuse for fires in electric stations. Oil switches should be built outside of stations wherever possible. Electric apparatus fires are bound to occur, but can be confined if such apparatus is installed in open places and not located adjacent to inflammable structures.

In carrying your own insurance, a sinking fund in actual cash should be created, deposits made monthly, and the old line insurance dropped gradually, leaving the most hazardous properties until the last.

Causes of Fires in Properties of Pacific Gas and Electric Company.

1909.

PROPERTY DESTROYED.	CAUSE.	DATE.
Roof fire	Hot smokestack	2-15-09
Roof fire	Hot smokestack	4- 7-09
Machine shop	Sparks	5-25-09
Sub-station	Electrical	8-22-09
Interior of warehouse	Fire-pot	9-13-09
Interior of sub-station	Arc	9-25-09
Construction camp buildings	Lamp explosion	11-16-09

1910.

PROPERTY DESTROYED.	CAUSE.	DATE.
Roof fire	Hot smokestack	2- 1-10
Oil tank	Incendiary	2-28-10
Switch house	Breakdown of oil sw.	3- 9-10
Roof fire	Hot smokestack	3- 9-10
Sawmill	Presumably sparks	3-10-10
Wall of gas building	Oil	3-10-10
Wall of electrical sub-station	Electric wires	3- 7-10
Switch house	Breakdown of oil sw.	4-24-10
Roof fire	Breakdown of high tension wires	5-16-10
Warehouse yard	Rubbish—spontaneous.	5-16-10
Packing cases and excelsior	Spontaneous	5-19-10
Stairs in branch office	Rubbish	5-23-10
Frame warehouse building	Unknown	6- 9-10
Purifier house walls	Sparks	6-22-10
Ditch house dwelling	Rubbish	6-26-10
Gasoline fire (man burned)	Matches on floor	6-21-10
Floor slightly burned	Oil switch	7-25-10

PUMPING FOR IRRIGATION IN WASHINGTON[1]

BY H. L. MOODY.

While Nature did wonders for mankind when she created the fertile valleys, rushing streams ad noble forests, the mineral-laden mountains and incomparable climate and rugged scenery in the territory out of which the State of Washington has been carved, she was parsimonious with her rainy days on the east side of the Cascade Range. These majestic peaks seem to act as barriers against the rain-clouds from the Pacific ocean, and, as a result, man has been forced to exercise his ingenuity and mechanical skill in supplying moisture by artificial means. His successes are evidenced by the fact that fully 265,000 of a total of more than 450,000 acres under ditch already have been made highly productive by the application of water from our rivers, lakes, streams and wells, and that the United States government and private corporations are bringing other large areas, approaching 400,000 acres under water.

Practically every modern method of supplying water for irrigation purposes is practiced in the valleys in eastern Washington, where several millions acres of land is adapted to intensive cultivation. The so-called arid belt extends from the eastern foothills of the Cascade mountains to the Idaho border. The land is generally covered with sage-brush and bunch grass. The

[1]Synopsis of address at the Eighteenth National Irrigation Congress, Pueblo, Colo., September 26 to 30, 1910.

soil has the requisite chemical and physical properties, being composed mostly of volcanic ash, decomposed lava and disintegrated basaltic rock, and probably has no equal, certainly no superior, in the world for richness and productivity. Abundant water is available for irrigation, but the chief problem with some has been to get it onto the lands.

Pumps are used in several districts, the power plants ranging from small gas-engine installations to mammoth hydroelectric establishments, and the results have been gratifying in almost every instance where business principles were applied and carried out in the management of the plants.

Many gas and oil engine pumping plants are lifting water from the Columbia river onto many of the lower bars and benches. These plants range from 10 horsepower outfits, lifting about 30 feet, to 250 horsepower installations, working against a 250-foot head. With the coming of water-power developments along the Columbia river it is likely that most of the new installations and many of the older ones will use electricity.

At present there is about 20,000 acres of land under ditch from the Wenatchee river and its tributaries, the Icicle, Peshatin, Mission and Squillchuck creeks. A 75-foot lift, with abundance of power easily developed from the Wenatchee river, will put water onto 4000 or 5000 acres of bench land, making a total of 25,000 acres of irrigated lands in the valley of the Wenatchee. This acreage does not require more than 25 per cent of the minimum flow of the stream during the irrigation season.

The Wenatchee Water Power Company has an appropriation of 150 cubic feet per second from the Wenatchee river. The rights which originally cost $30 an acre, now are held at $100. Maintenance charges are $1.25 to $1.50 an acre.

The Prosser Falls Land, Irrigation & Power Company irrigates about 1600 acres on the south side of the Yakima river, opposite the government's Sunnyside project. The water is lifted 100 feet by pumps, being forced through 1800 feet of 28-inch steel pipe to a penstock, from which the canal heads. The turbines driving the pumps operate under a head of 17 feet. The early contracts provided for one cubic foot per second for 120 acres, while the latter ones agree to give one cubic foot for each 160 acres. Water rights cost $75 an acre and maintenance charges are $1.50 an acre.

The Moses Lake Development Company is lifting water 50 feet with a 40 horsepower gas engine to irrigate 325 acres, some of which is now in young orchards. Maintenance charges are $2.50 per acre per year. Near Moses Lake is a 20 horsepower gas outfit lifting water from a well sunk 29 feet into gravel.

The Fruitland Irrigation Company has a project watering 6000 acres on the east bank of the Columbia river in Stevens county. Water is taken from the Colville river below Meyers Falls.

The Plantations Company's project is between Meyers Falls and Kettle Falls on the Columbia river. The elevation is 1600 feet. This is high bench land and adjoins the Fruitland irrigation properties on the north. Water will be lifted 105 feet by water power into a 100,000-gallon reservoir, from which it is to be carried in a 20-inch wood stave pipe under pressure and delivered to each 10-acre lot from a hydrant. The contracts call for one acre-foot of water per acre between May 1 and September 15.

The Hazelwood irrigated farms are located on a plateau of gently rolling prairie, at an elevation of from 2200 to 2300 feet, covering 2500 acres. The property comes up to within four miles of the city of Spokane. Water supply is lifted by an electrically-driven 15-inch centrifugal pump from Silver lake, a body of clear, potable water, covering approximately 700 acres. This pump, operating against a lift of 60 feet, discharges 8660 gallons a minute through a 36-inch wood stave pipe into a small basin, from which it is carried to the edge of the property in an open ditch.

The distributing system is largely of machine-banded wood stave pipes, through which the water is delivered to the high point of each 10-acre subdivision. The operating company contracts to supply water at the rate of one cubic foot per second for each 200 acres of land. The water is measured to the settler over a weir on his land and is supplied by the rotation method, so that he has always a good head of water with which to work. Maintenance charges are $2.50 per acre per year, which is estimated to be the actual cost of the service.

The Adrian Irrigation Company is installing a pumping plant at Brook lake near Adrian and contemplates watering about 2000 acres from the natural flow of Crab creek.

The Kennewick Canal Company is lifting water from the Kennewick canal 100 feet onto a plateau of 3000 acres immediately west of Kennewick. One cubic foot per second of water is allowed for each 160 acres of land. The water is measured to the consumer over a weir. The maintenance charge is $1.50 per acre per year.

At White Bluffs, on the west side of the Columbia river, the White Bluffs Land & Irrigation Comjany has installed a pumping plant to lift water 50 feet from the Columbia river onto 2500 acres of sagebrush land at an elevation of 450 feet above sea level. The water is distributed under pressure through machine-banded wood stave pipes ranging from 8 to 24 inches in diameter.

The original installation consisted of two producer gas plants of 100 and 150 horsepower, respectively, supplying gas to two engines, one of 100 and the other of 150 horsepower. These engines were coupled to two vertical centrifugal pumps, one 10-inch pump rated at 3000 gallons per minute and the other a 12-inch pump rated at 4500 gallons per minute. The annual maintenance charge is $2 per acre and the water supplied is one cubic foot per second for each 160 acres.

The water used for irrigating the Hanford lands is pumped from the Columbia river in Benton county, where two pumps, with a combined capacity of 83,000,000 gallons a day, sufficient for 16,000 acres, are in successful operation. The pumps are operated by electric power, which is generated at Priest Rapids, in Yakima county, where a large power plant has been constructed. The induction motors and pumps in operation are of the vertical centrifugal type, carrying the

motor directly connected to the shaft. The speed of the motors is synchronous with the generator and the column of water pumped is controlled by regulating the speed of the turbines. Their nominal capacity of 64 cubic feet per second each at a speed of 175 revolutions per minute.

Just above Pasco, on the Columbia river, is the Moore project watering 1000 acres. The plant consists of a 100-horsepower installation working against a lift of 45 feet. This is one of the largest of the many small plants along the Columbia river.

The Drumheller Development Company's project, irrigating 1600 acres, lifts the water 50 feet. The installation consists of a 100-horsepower gas producer and engine operating a single-stage centrifugal pump with a rated capacity of 3000 gallons per minute.

At Paterson, on the lower Columbia river, is a pumping plant consisting of a 250-horsepower producer gas plant, driving a three-step centrifugal pump operating against a head of 250 feet. The distribution is through pipes and 400 acres of land is watered. When completed the plant is intended to cover 1800 acres.

On Blalock Island, in the lower Columbia basin, is a gas plant pumping water for 500 acres. This is a 100-horsepower plant operating against a maximum lift of 35 feet. The water is distributed through wood and iron pipes. Smaller installations have been made at other places along the Columbia river and water a considerable body of highly productive land.

The Lewiston-Clarkston Company utilizes the water of Asotin creek for power and irrigation purposes. It waters 8000 acres in and about Clarkston, near the confluence of the Snake and Clearwater rivers. The water for these lands and for power is carried from Asotin creek in a 48-inch steel-banded wood stave pipe to the power house from which a 40-inch pipe carries it to the point of division for the two benches. A 32-inch pipe serves the lower bench, and after delivering the water to a power plant the waste is collected in a reservoir for use in irrigating the lower levels. These lands lie generally in two benches and range from 750 to 1250 feet in elevation. The water service is entirely through pipes and is measured to the consumer through a disk meter.

The Pasco Power & Water Company, a few miles above the mouth of Snake river, is installing a pumping plant to water about 12,000 acres of sandy land in the vicinity of Pasco. The present installation consists of a cycloidal rotary pump working against an 85-foot head and driven by a water turbine under a nine-foot head.

The La Follett orchard of 325 acres at Wawawai gets most of the water needed from Wawawai creek and supplements it by pumping from the Snake river.

The Columbia Canal Company, which has 5000 acres under the ditch near Attalia, is augmenting its water supply by the installation of a 100-horsepower gas engine and a 10-inch horizontal centrifugal pump discharging through a 20-inch machine-banded wood stave pipe under a 28-foot lift. The maximum capacity of the plant is given as 10 cubic feet per second.

The Blalock Fruit Company pipes the sewage from Walla Walla, a city of 30,000 population, to its 900 acres of orchard and vegetable and alfalfa lands. This is supplemented by two artesian wells and water taken from Mill creek.

Peach, at a point where Hawk creek empties into the Columbia river, below the mouth of the Spokane river, which now has 400 acres of peach orchards under irrigation, contemplates putting in a pumping plant to irrigate 200 acres more.

There are several important pumping plants in the Spokane valley, where from 75,000 to 80,000 acres of land is adapted to irrigation. The Spokane valley comprises a comparatively level prairie extending from Spokane to Coeur d'Alene, Idaho, a distance of 34 miles, and for some miles west of Spokane, and from three to eight miles in width. This is closely backed on either side by timbered foothills covered with evergreens. The irrigated and irrigible lands lie at an elevation of 2000 feet.

The soil is composed of a rich black volcanic ash, mixed with small gravel. It is from a few inches to several feet in depth and is underlaid with a thick bed of boulders and gravel. The average rainfall for a long period of years has been 17.91 inches. Previous to irrigating any of this land most of it had been planted to wheat, oats and barley, with an occasional small orchard. It is now largely devoted to fruits.

The Modern Irrigation & Land Company's plant at Opportunity covers 2700 acres and is watered by wells ranging from 90 to 134 feet in depth. The water is lifted by vertical centrifugal pumps, direct-connected to horizontal motors, installed at the bottom of the wells above the high water. More than 50 per cent of the water is distributed in open ditches, the rest mostly in pipes. There is a separate system for domestic use and 48-candle power electric lights. The average cost per acre for water, including domestic supply and lighting is from $5 to $6.50 a year. The maintenance cost is light.

The Vera Land Company's project covers 2300 acres. The land was worth about $75 an acre in 1908. There are three wells on the property, the deepest being 130 feet. The turbine pumps are direct-connected with motors, which are placed in the tunnel above high water. Eighty-five per cent of the water is distributed in cement pipes, the rest in open ditches. This company finds that cement is cheaper than clay pipe and both cheaper and better than wood. The average cost for irrigating and domestic supply and electric lighting is from $5 to $6.50 an acre.

Other pumping projects in the Spokane Valley are at Post Falls, 3000 acres; Hayden Lake, 3200 acres, and Dalton Gardens, 1000 acres. I am told that several companies contemplate adding 4000 or 5000 acres the coming season.

This sums up the salient points of what has been accomplished in a masterly, unspeculative and far-seeing way in conquering the waste places in the state of Washington by pumping water onto the lands—a practical demonstration of a scientific fact that the application of water and intelligent cultivation has transformed thousands of acres of land once a wilderness, so unpromising that it evoked derision in the halls of Congress, into veritable garden spots and peopled it with thrifty, prosperous and optimistic men, women and children, who have found happiness and fortune in the Land of Opportunity.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

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604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE. 150 NASSAU STREET. NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE. 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States. Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Arc Light

Recent improvements in the efficiency of incandescent electric lamps have been so emblazoned in public attention that equally great increase in arc lamp efficiency has been partially eclipsed. Greater changes have been wrought in the arc lamp during the first tenth of the twentieth century than in all the preceding hundred years since Sir Humphrey Davy first discovered that an "arch" of flame resulted from passing an electric current between two charcoal points.

The sputtering, hissing arc light that many of us recollect in our childhood was ever at the mercy of the wind. Like an oil lamp, it was easily blown out unless operated at such excessively high amperage that the carbons were burned before the night was half over. This was remedied in the early nineties by enclosing the carbons in an air-tight globe which excluded both wind and oxygen, so their life was lengthened twelvefold, though the efficiency was slightly lowered.

Although the arc is inherently best adapted to a direct current which heats the positive carbon so highly that more than four-fifths of the light comes from its incandescent crater, yet the convenience and advantage of alternating current distribution makes its use desirable in many cases. Much ingenuity has been exercised in producing the proper feeding mechanism to meet the present exacting requirements until there are now thousands of arcs operating satisfactorily on alternating current, albeit at lower efficiency. This has been largely corrected in the so-called intensive arc, which employs two positive and one negative carbon.

Having exhausted the immediate possibilities of the carbon arc, scientists next substituted an electrode impregnated with the salts of substances such as calcium, which, when vaporized, gives a luminous stream far brighter than the incandescent carbon tips. This flaming arc gives a soft yellow light with either direct or alternating current. Its chief disadvantages are the fumes and the rapid consumption of the rather costly electrodes. These defects are partly obviated in the regenerative arc lamp in which the heated vapors are kept in circulation before condensing or escaping, thus conserving both the heat of the arc and the vapor supply. Tests have shown that a mean hemispherical candlepower may be produced with one-fourth watt and an electrode life of seventy hours.

The luminous, or magnetite, arc, which has a longer life and better light distribution, can be used only on direct current circuits. This employs an inert copper anode and a cathode tube in which is packed a mixture of the oxides of titanium, iron and chromium, the first being for luminosity, the second for conductivity and the third for retarding the rate of burning. Under this classification there is also the mercury arc, whose unpleasantly colored light may yet be rendered acceptable for general illumination by means of a recently perfected "step-down" fluorescent screen, thus making available this most efficient light-giving source.

PERSONALS.

W. S. Heger, California manager for the Allis-Chalmers Company, is at Los Angeles.

E. C. Bradley, general manager of the Pacific Telephone and Telegraph Company, is at New York.

Harry P. Rice, vice-president of the General Incandescent Lamp Company of Cleveland, Ohio, is at San Francisco.

A. K. Andriano, managing director of the Direct-Line Telephone Company, recently returned to New York City.

Sidney Sprout has returned to San Francisco after making an electrical engineering investigation in San Luis Obispo County.

Thomas M. Debevoise and Franklin Overbaugh are at Del Monte and will attend the jobbers' meeting at Catalina Island next week.

E. C. Jones, chief engineer of the Pacific Gas and Electric Company's gas department, has returned to San Francisco from Los Angeles.

J. A. Lighthipe, engineer for the Edison Electric Co. of Los Angeles, has returned from an automobile vacation trip through Southern California.

C. M. Bliven, apparatus salesman with the General Electric Company, was married September 20th to Mrs. Edna Browning Harlan, at Sacramento.

E. V. D. Johnson, superintendent of the Northern California Power Company, returned to Redding last week after attending a meeting at San Francisco.

O. K. Jones, who was for the past ten years an inspector with the Department of Electricity of the city of San Francisco, has joined the sales corps of the Holabird-Reynolds Company.

Paul Shoup, assistant general manager in charge of the Southern Pacific Company's electric railway lines, has returned to his San Francisco office after spending several days at Los Angeles.

G. A. Harvey, formerly electrical engineer of the International Traction Company, Buffalo, N. Y., is assisting Horatio A. Foster with the Southern California Edison Company, Los Angeles, Cal.

E. Reinhart, manager of the Winnemucca Water and Light Company, who visited San Francisco during the past week, contemplates remodeling his light and water plant at Winnemucca.

A. L. Adams has been appointed superintendent of distribution of the Puget Sound Electric Railway and the Tacoma Railway & Power Company, Tacoma, Wash., reporting to K. C. Schluss, superintendent of power of these companies.

Seton Porter, of Sanderson & Porter, who has spent the past two months at his San Francisco office, departed for New York last Wednesday. Wynn Meredith, Pacific Coast manager for the firm, is still in British Columbia on business connected with a hydroelectric installation.

TRADE NOTES.

The Fort Wayne Electric Works has sold to the Sacramento Valley Power Company of Redding three 300-kw. water-cooled transformers for operation on 55,000-volt circuits.

Charles E. Cookerly, for three years foreman of the Morrison Electric Company of Portland, has purchased the stock and good will of the Pacific Electric Engineering Company of Eugene, Ore.

The General Electric Company reports the sale of the following generating apparatus to the Northwestern Corporation of Springfield, Ore.: H. M. Byllesby & Co., engineers, one A. T. B. 4, 2000 k.w., 1800 r.p.m., 2300 v., horizontal condensing Curtis turbine generator, arranged for 150 lbs. steam pressure.

ANNUAL JOVIAN MEETING.

The eighth annual meeting of the Rejuvenated Sons of Jove will be held at Birmingham, Ala., on October 13, 14 and 15, 1910, this being the home of the reigning Jupiter, Oscar C. Turner, No. 333-3. Birmingham has a Jovian membership of about one hundred, and every one of these members is thoroughly active and interested. They promising all visiting Jovians three live days, and special preparation has been made for the entertainment of the ladies at the Country Club and elsewhere.

The Order of the Sons of Jove is a fraternal order of electrical men throughout the United States, Canada and Mexico. It has now a membership upwards of four thousand and is growing rapidly. During the past year the membership has been increased by over one thousand members in all parts of the country. The object of the order is frankly commercial. It aims to bring about a greater degree of harmony and co-operation among those engaged in the same line of business by getting into closer contact all branches of the industry. It strives to eliminate petty jealousies, unfair methods of competition and elements of friction; to increase the common market by co-operative advertising, Jovian lunch clubs where questions touching on the welfare of the business are discussed, and the cultivation of the spirit of harmony and loyalty.

The order was founded in the South in 1899, but for several years did not spread outside of the original territory, During the past three or four years the growth has been phenomenal and to-day the order is one of the recognized forces for good in the entire electrical world. Its membership includes many of the best known men engaged in electrical pursuits, all of whom are active in the furtherance of its objects.

ALEXANDER HENDERSON MEMORIAL FUND.

In the death of Alexander Henderson, the entire electrical fraternity lost not only a pioneer and an indefatigable worker in its cause, but to many the loss is a deep and personal one. To those who knew him best what a world of meaning now attaches to the hearty hand clasp and the familiar "How." With it from him went the unspoken but unselfish cheer and good will. Never a word nor thought of envy nor criticism for a business rival or competitor; he spoke no ill of any man.

A short time before his death, two friends stood by his bedside, grasped his nerveless hands and greeted him with the old familiar "How." A faint smile and flash of understanding in the fast dimming eyes conveyed to all three its broader and deeper significance.

In this hurly burly strenuous every day life of ours there is too little of the deeper sentiment which should be part of our nature and life. We may appreciate for the day or time being those little acts of kindness and thoughtfulness of which we are recipients but are too apt to forget. Shall we forget shortly these many acts of kindness, thoughtfulness, tact and courtesy of which we are all recipients time and again? Thoughtful acts which many times meant self sacrifice.

To quote a friend:

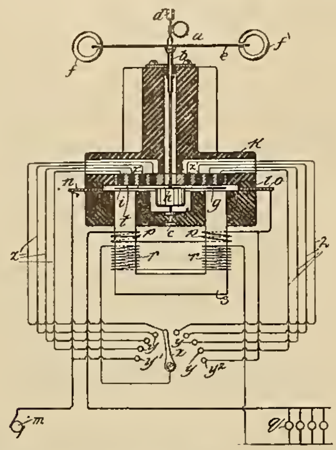
"We were content to know and love the Alex. Henderson of the hour, and how much we did like and admire him we hardly ever realized until he was gone from us forever. This is too often the way with us mortals—we only appreciate at its real worth that which has been lost."

Let us then show the esteem and appreciation we held for the man who has gone from us, by a lasting memorial which will symbolize in enduring stone the deeper significance of his "How."

A committee has been formed to carry out the suggestion of erecting a memorial, contributions being requested from the manufacturers, jobbers, contractors, inspection department, Sons of Jove and technical press.

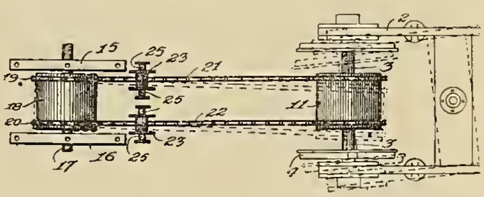
PATENTS

970,498. Electric Meter. Jesse Harris, La Fayette, Ind., assignor to Duncan Electric Manufacturing Company, La Fayette, Ind. An electric meter including an armature, a liquid-containing chamber inclosing said armature, circuit



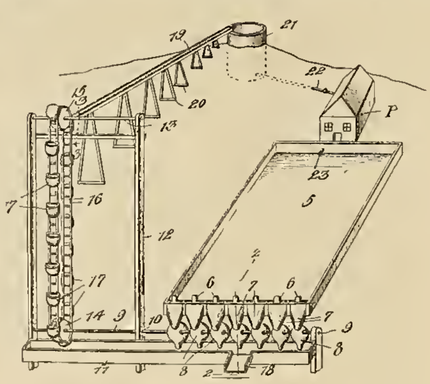
connections whereby the liquid may be included serially in a distribution circuit, and regulable means whereby varying portions of the liquid may be included across the mains of the distribution circuit.

970,543. Railway Power Transmission. Albert S. Parsons, Berkeley, Cal. In a device of the character described, a vehicle, a power shaft therefor, a drum-shaped pulley having sprocket teeth on its periphery adjacent to each end thereof, said pulley being universally mounted on and driven by said



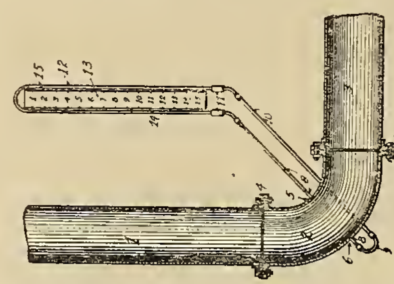
shaft, an axle mounted in a pivot support and spaced apart from said power shaft, a drum-shaped pulley having sprocket teeth on its periphery adjacent to the ends, said pulley being universally mounted on and driving said axle, and sprocket chains connecting said pulleys.

970,796. Supply System for Water-Power Plants. Charles Franklyn Clark, Calistoga, Cal. A water supply system of the character set forth comprising a main reservoir adapted to be arranged adjacent to a body of water affected by the tides,



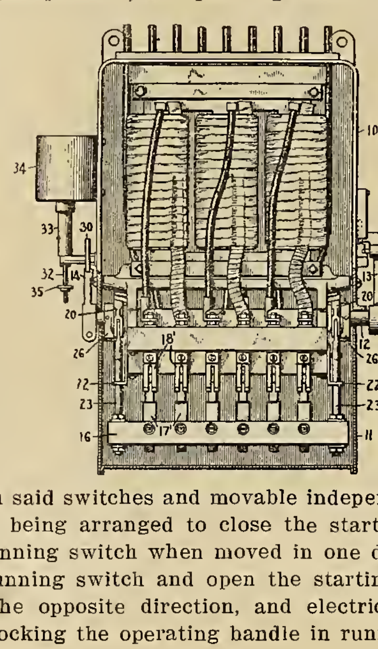
said reservoir being filled by the rise of the tide, a power shaft mounted in bearings adjacent to one end of the reservoir, means for controlling the discharge of water from the reservoir, means arranged on the shaft to receive the water so discharged and rotate said shaft, a frame structure arranged adjacent to the reservoir, a shaft mounted in the upper end thereof, a sprocket on the power shaft and the shaft in the upper end of said frame, and endless chain connecting said sprockets and carrying a plurality of buckets, a trough arranged beneath said shaft to receive the water discharged from the reservoir, said buckets being adapted to elevate a portion of the water to the top of the frame, a second reservoir arranged at a higher elevation than the first named reservoir, an inclined flume extending from the upper end of the elevator to said reservoir, and a water conducting pipe connecting said reservoir to the power plant.

970,965. Method of Measuring the Flow of Fluids. James Buckner Speed, Berkeley, Cal., assignor of one-half to Andrew Murray Hunt, Berkeley, Cal. A process of measuring the rate of flow of a fluid which consists first in causing the fluid to flow through a curved conduit which is filled by the fluid and has a uniform circular cross section, and the center line thereof a constant radius of curvature for a part at least of



the length of the curved portion; second, in measuring the difference between the pressures on the inner surfaces of the concave and the convex sides of said part; third, in computing the flow according to a suitable rule which takes into account the diameter of the circular section, the radius of curvature of the curved conduit where it is uniform, and the said difference in pressure.

970,478. Circuit-Controlling Device. Parker Dunning. Schenectady, N. Y., assignor to General Electric Company. A starting device for electric motors comprising a starting switch and a running switch pivoted concentrically and both biased to open position, an operating handle pivoted concen-

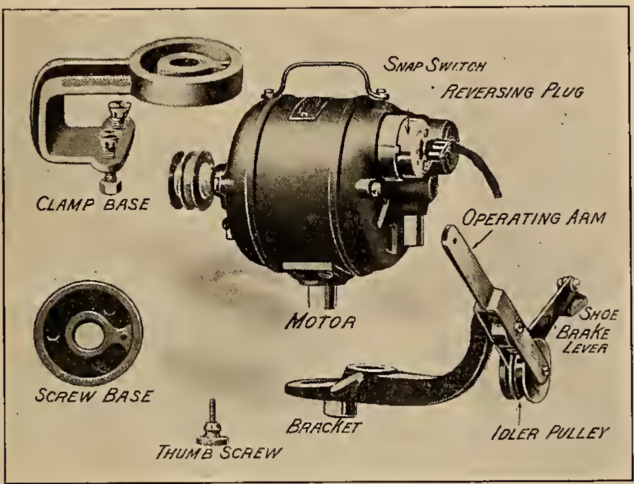


trically with said switches and movable independently thereof, said handle being arranged to close the starting switch and open the running switch when moved in one direction and to close the running switch and open the starting switch when moved in the opposite direction, and electrically controlled means for locking the operating handle in running position.

INDUSTRIAL

WESTINGHOUSE GENERAL UTILITY MOTOR.

The general utility motor now being placed upon the market by the Westinghouse Electric and Manufacturing Company marks the latest advance in the application of electric motors to household convenience. By means of its special attachments the motor can be adapted to a variety of uses about the house. The new motor commends itself heartily to



Westinghouse General Utility Motor.

the favor of central station companies, as it provides another wedge for the introduction of electricity into the home. Furthermore, it is essentially a day load. The motor takes from 40 to 120 watts for its operation.

The general utility motor can be readily arranged to operate the following devices: Family sewing machine, buffing,

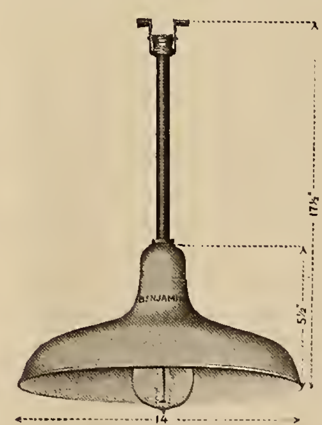
Motor Polishing Silverware.

polishing and grinding wheels, ventilating blower, jewelers' lathe, light machinery, small lathes, sign flasher, moving window display, mechanical toys, etc. The motor is sold complete with one or more attachments. Further attachments can be obtained by the purchaser as desired. A different attachment is not necessary for every one of the uses mentioned above, as some of the attachments make the motor available for several purposes without change. The general utility ventilating outfit is one of the features of the new apparatus. The small blower will supply fresh air to the kitchen, increase the draft of a furnace, remove foul air from sick rooms, and readily adapt itself to any small ventilating work. By fitting the blower openings with suitable pipe, air currents can be directed wherever desired.

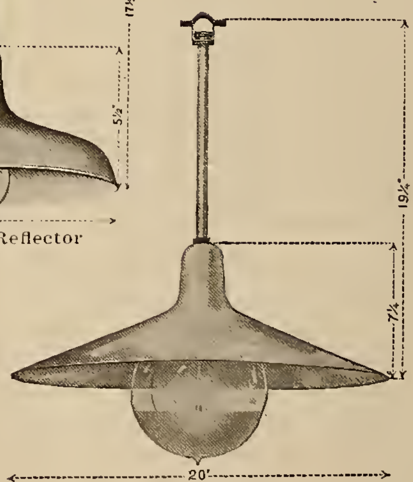
The general utility motors are made for operation on 115 and 230 volt direct-current circuits, and on 110 and 220 alternating circuits of 60 and 133 cycles. The direct-current motors are shunt wound, while the alternating-current motors are of the induction type, single phase. The motors run at a speed of 1700 r.p.m. The motor is light and can be easily carried from place to place by means of a handle in the top of the frame. It is artistically finished in black enamel to harmonize with the other house decorations. The applications of the attachments are positive; it is impossible to put them on wrong.

BENJAMIN REFLECTOR SOCKETS.

A new line of devices is being placed upon the market by the Benjamin Electric Mfg. Co. of Chicago. They consist of a deeply hooded one-piece enameled steel reflector with threaded brass bushing tightly clamping the reflector between two leather washers and an especially designed receptacle or socket. Reflectors furnished are of two general types—flat cone (distributing), for wide distribution, and bowl-shaped



Flat Cone Reflector



Bowl-shaped Reflector

(diffusing), for medium distribution. The hooded portion varies in diameter to accommodate three kinds of lamps, namely, carbon and short base, skirted base, and large base. Reflectors suitable for intended distribution may thus be secured. Each is designed for use with a definite range of lamps and with particular regard for the correct relation of lamp filament and reflecting surface. The present demand for fixtures permitting the use of large base, i. e., 400 and 500 watt metal filament lamps, practically assures the commercial success of this line of devices.

NEWS NOTES

FINANCIAL.

CORNING, CAL.—A special bond election will be held October 4th to vote on incurring a bonded indebtedness of $46,800 for waterworks system and $22,000 for sewer system.

SANTA BARBARA, CAL.—The City Council will receive sealed bids up to 5 p. m. October 6th for the purchase of waterworks extension tunnel bonds in the sum of $40,000, which is a part of the $200,000 voted; bonds are $1000 each at 4½ per cent.

PORTLAND, ORE.—Pooling their claims, aggregating $800,000, creditors of the Deschutes Irrigation & Power Company have joined in a petition for an immediate foreclosure of the first mortgage on the company's property. The order was granted by Judge Charles E. Wolverton, who appointed Receiver C. M. Redfield a special commissioner to handle the sale. It is announced by L. G. Addison, representing the Ohio bondholders who caused the Deschutes Irrigation Company to be placed in the hands of a receiver as bankrupt, that every effort will be made to protect the investment of the 600 or more stockholders. As intended at this time and as a part of the plans under which action was taken last week, the creditors will buy in the property at the advertised sale and will immediately wind up the affairs of the Deschutes Irrigation & Power Company by the organization of a new holding company. The new concern will be called into existence for the sole purpose of handling the assets in such a manner that the debts may be cleared from the records and a dividend secured to the stockholders.

INCORPORATIONS.

ALAMEDA, CAL.—The Sunset Power Company has been incorporated by C. B. Greeley and T. Turner with a capital stock of $500,000.

ELMA, WASH.—The Olympic Railway & Power Company, capital $3,000,000, has been incorporated by F. W. Downs and Thorvald Hvam.

SAN FRANCISCO, CAL.—The Gough Street Railway Company has been incorporated by A. J. Pon, David Livingston and Charles Loisch, with a capital stock of $60,000.

RIVERSIDE, CAL.—The Trujillo Water Company has been incorporated by S. C. Evans, M. S. Evans, M. M. Grip and others of Riverside, with a capital stock of $2640.

TRANSMISSION.

RICHMOND, CAL.—The Great Western Power Company has asked for a franchise to set poles, string wires, etc., for supplying electric power to consumers.

ALBANY, ORE.—The County Court has granted the franchise of the Tri-State Railway & Power Company for an electric power line from this place to Eugene.

ANACORTES, WASH.—The Anacortes Water & Light Company is doubling the capacity of its plant, installing new and up-to-date machinery that will supply continuous power for manufacturing concerns.

TOPPENISH, WASH.—Charles D. Fullen, attorney, 1063 Empire building, Seattle, has secured control of the reservation electric light plant at Toppenish. Julian Fullen has been elected general manager of the company and will take full charge of the plant.

SEATTLE, WASH.—The Western Steel Corporation has arranged with the Olympic Power & Development Company for 2500 horsepower, to be delivered within eighteen months, with an option of 2500 additional horsepower. The Olympic Power & Development Company is now building a $500,000 power plant on the Elwha river, six miles above Port Angeles.

TOMBSTONE, ARIZ.—Within the next few months a new power line will be installed between Prescott and Jerome, supplying power to that district from the Prescott Gas & Electric Company. One line is already in operation, but a new one will be installed to furnish additional power and to act as a substitute line in case of damages to the wires now in use.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company is constructing an 18,000-volt pole line about 15 miles in length for the purpose of connecting Modesto with its main tower-line. Heretofore the town has had to depend entirely upon the Knights Ferry power plant for current. In the future there will be two independent lines from the above system into Modesto, where a new substation will be installed.

SAN FRANCISCO, CAL.—George W. Bacon and F. J. Jackson, general manager of the Sierra & San Francisco Power Company, with J. G. Anderton, the Sonora manager, recently made a tour of inspection of all the company's dams and dam sites on the South Fork of the Stanislaus river, above Strawberry. The lower Strawberry dam has been in a bad condition for some months. The equipments employed at Relief will be transferred to the Strawberry reservoir and a large force of men will be put to work to complete as much as possible before the heavy snow fall. The work will again be resumed in the spring until the reservoir is in first-class condition, materially increasing the storage capacity of the dam and preventing an occurrence of the shortage of water experienced this season.

ILLUMINATION.

NYSSA, ORE.—The City Council has granted to the Idaho-Oregon Light & Power Company a 25-year franchise for an electric light system. The system is to be installed in the course of six months.

PORTLAND, ORE.—J. W. Travers has petitioned the Council for a franchise to operate a gas plant, to be located in the Rose City Park district. If the franchise shall be granted work will be started immediately on the plant, to cost $100,000.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company, owner of the Western Boiler Works, will erect in place and connect to present suction gas piping and steam exhaust pipe certain pipe lines, etc., for a gas plant at Aliso and Center streets, at a cost of $2500.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company, representing a consolidation of the Baker City Light & Power Company, the Fremont Company and the Grade Ronde Power Company, with principal offices in Baker City, has under advisement the extension of its lines to Imbler and Elgin, a distance of some 20 miles.

SALINAS, CAL.—John M. Gardiner, vice-president of the Monterey Electric Light & Power Corporation, who has been acting as chief executive since the death of the president, George Hazelton, has been assigned the duty of reorganizing the finances of the concern. He says: "In the improvements we have mapped out for this section we are figuring on the ultimate extension of the electric line. The company will invest $500,000 in improvements in this county during the next 12 months. They include extensions of the water system of Salinas and the betterment of the gas service."

TRANSPORTATION.

LODI, CAL.—The Central California Traction Company has decided to run a loop through this city.

SAN DIMAS, CAL.—F. A. Hamm, who owns a ranch of ten acres at San Dimas, has been awarded $1200 for a right of way across his property that takes up one acre which is desired by the Pacific Electric Company for an extension of its Covina line.

POMONA, CAL.—Work on the extension of the Pacific Electric road between Claremont and Upland is delayed. Rails and ties have been on hand for some time and citizens who provided the right of way are anxious for some action on the part of railroad officials.

SAN DIEGO, CAL.—The City Council will receive sealed bids up to 11 a. m. October 3d for a certain franchise to construct, maintain and operate for a period of 25 years a street railway on Fifteenth street, from K to M streets. The San Diego Railway Company has applied for the franchise.

PHOENIX, ARIZ.—General Manager Mitchell of the Phoenix Railway Company has made the statement that if plans already made by the company are carried out the company will spend between $125,000 and $135,000 in Phoenix and vicinity on improvements and extensions on the line before July 1st of next year.

SALT LAKE, UTAH.—The County Commissioners have granted the amended franchise for operation of an interurban electric railroad to Leo Neilsen and his associates. The route is from Wellsville to Hyrum, thence along the east edge of the valley to Logan, touching the towns of Millville and Providence. From Logan, it goes through Greenville to the Idaho State line, passing through Hyde Park.

BERKELEY, CAL.—Superintendent W .R. Scott of the Southern Pacific Company announces that within six months the time of transportation between Berkeley and San Francisco will be shortened ten minutes on the S. P. ferry system, and the fast time of 35 minutes now made by the Key Route Company will be shaved five minutes, landing passengers on either side of the bay in just an even half hour.

ALAMEDA, CAL.—Industrial Agent F. W. Hoover of the Southern Pacific has informed the Council that, owing to a delay in filling the rolling stock orders, the new electric train service will not be put in operation until next April. The Council has granted to the company a power-line franchise to enable the company to build a connecting pole and trolley line from the auxiliary plant on the Fruitvale side of the tidal canal to connect with the new Alameda electric line.

FRESNO, CAL.—F. S. Granger of the proposed Fresno-Hanford Interurban Railroad, which will now extend only to Kingsburg, leaves this week for New York, where he will complete arrangements for the starting of work on the new road. The bonds have all been subscribed. The Hudson Counties Improvement Company, a subsidiary organization to the Carnegie Trust Company, in which the bonds will be held, is to build the local road. Mr. Granger states that the rights of way for the road are all in good shape and that the deeds will be placed on file while he is away.

LOS ANGELES, CAL.—At a special meeting of stockholders of the Los Angeles Railway Company, recently held at Santa Barbara, the question of increasing the capitalization of the company from $5,000,000 to $15,000,000 was considered. There were present H. E. Huntington, Howard Huntington, Ward, and W. F. Herrin, representing the S. P. interests in the company. These bonds are to cover improvements now under way and extensions that are needed to supply increased traffic wants of Los Angeles. President H. E. Huntington explained this large issue by saying that it was to provide for considerable work that had been done, and more work that is to be done.

SAN DIEGO, CAL.—Transfer of the franchise and holdings of the Keller-Kerckhoff Company's railroad, destined to extend from this city to Del Mar and eventually to Los Angeles, is reported. The Santa Fe is said to be the purchaser. The holdings include a franchise and right of way through the city limits to Del Mar, which is just outside the city. The Keller-Kerckhoff holdings in the main consist of a franchise and a partially graded roadbed. It is said to be the intention of the Santa Fe to use the right of way for the extension of its line from Del Mar into San Diego by way of La Jolla.

SAN FRANCISCO, CAL.—The Supervisors have adopted a resolution formally accepting the bid submitted by T. W. Forsyth for the purchase of the franchise for the proposed extension of the Parnassus-avenue street railway, from the Affiliated Colleges to Judah street, Ninth avenue and Pacheco street, the bidder agreeing to meet the charter requirements by paying the city 3 per cent of the gross receipts of the new road for the first five years of the life of the franchise, 4 per cent during the next ten and 5 per cent during the final ten years. The road will be built and operated by the United Railroads Company, to which the privileges secured by Forsyth and his associates will be turned over, together with the $40,000 bonus raised by interested property-owners.

WATERWORKS.

RED BLUFF, CAL.—Secretary E. D. Warmoth of the local Chamber of Commerce has filed notice of location on 300,000 inches of water to be taken from the Sacramento river and used for domestic, irrigation and power purposes. The point of diversion is on the west bank of the river near the site of the dam of the Iron Canyon project, and the importance of the location depends on its relation to that project.

PLACERVILLE, CAL.—A deed of trust and other papers have been filed here which indicate the formation of a water and electric company to develop power from 50,000 inches of water from Rock Bound lake and Buck Island lake above this city. The company owns 25,000 inches from each place and will build dams to increase the capacity. Arthur Bloch of Oakland is back of the deal and the filings were made in his name. The Mercantile Trust Company of San Francisco holds the deed of trust.

LOS ANGELES, CAL.—That a franchise granted to a private corporation is no bar to municipal ownership of any public utility, is the decision rendered by Judge Olin Wellborn of the Federal District Court in the case of the Madera Water Company against the City of Madera. The court held that grants and special privileges given by the public are to be construed in favor of the public. In rendering the decision, which was upon a demurrer interposed by the city, Judge Wellborn ruled against the corporation's contention that it held an exclusive franchise, and that in establishing a public water plant the municipality was violating the constitutional rights of the company.

LAKEVIEW, ORE.—Charles McIntyre, an engineer of Spokane, Wash., is here working in the interests of the South Oregon Water Power Company. This company is backed by Spokane capital, and its purpose is to develop the water power of Deep creek, located in the vicinity of Adel. As soon as the necessary rights have been secured the company will put in an initial plant which will develop 2500 h.p., but extensions are contemplated which will enable it to furnish 10,000 h.p. This power will be used in Warner valley, this valley, Surprise valley, California and Catalow valley, Harney county, for municipal, manufacturing and irrigation purposes. A franchise will be sought from the Council of this town so that the company may be enabled to sell their power here. At the present time there is no electric power obtainable during the day time.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 15 | SAN FRANCISCO, OCTOBER 8, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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STEAM TURBINES[1]

BY E. M. GILBERT.

In a brief paper of this description, it is not the intention to enter into a mathematical discussion of the theory of turbines, nor yet to compare different types and makes, but merely to give a few general details, considering these machines as a separate and distinct class of prime movers.

The field has been covered so completely in the many books and magazine articles published during the last few years, that one cannot hope to present anything new. As, however, this subject had never been taken up before the local society it was thought that a brief discussion of types, elementary theory, etc., might be of interest.

It is an interesting historical fact that the principles to which the turbines of today owe their classifications as belonging either to the "impulse type" or "reaction type" were discovered and exemplified by models or small machines many centuries before being put into practical use. This fact justifies a brief mention of these inventions.

Clean Sport of the Colorado Electric Light, Power and Railway Association at Glenwood Springs, Colorado.

Authentic record gives Hero the credit of designing the first turbine, placing the date at about 120 B. C. His design was based on the principle of reaction and was somewhat similar to the small revolving sprinklers so frequently used today for watering lawns, except, of course, that it used steam instead of water.

Nothing further is heard of steam turbines until the seventeenth century, when Branca invented an impulse machine. This merely consisted of a simple turbine wheel, against the buckets or blades of which steam was blown. The study of engineering at the

[1]Paper read before the Colorado Electric Light, Power and Railway Association at its eighth annual convention, at Glenwood Springs, Colo., September 21, 22, 23, 1910.

time of these discoveries had not been developed enough to enable use to be made of the inventions, so that they have no practical value except to illustrate the simplicity and age of the basic principles upon which all turbine construction is more or less dependent.

It was understood long before the practical use of turbines was demonstrated that the high peripheral velocity of simple turbines was a great obstacle, which must be overcome either by reduction through gears or some such appliance, or by a change in design of the machine itself. In the early part of the nineteenth century two Frenchmen invented a turbine, attempting to gain speed reduction by distributing the drop in pressure through several stages. This without doubt was the forerunner of the multistage machine so popular today. In 1883 De Laval took out a patent on a reaction type turbine, closely following the original design of Hero, and six years later another one (now known as De Laval turbine) using the Branca design, made practical by many improved features of the utmost importance. About this time Parsons also brought out his first machine, which is classed as belonging to the reaction type, although strictly speaking it seems to employ a combination of both principles.

Curtis in 1896 patented his machine, which, while using many of the essential features of De Laval's invention, applied them in such a way as to make practicable larger machines and slower speeds than those possible with the former design. The development of the turbine industry has been very rapid since the last date given, many of the machines produced being merely modifications of the three mentioned. In fact, the De Laval, Parsons and Curtis turbines may safely be taken as representative of types under which all machines are classified, i. e., single stage impulse type, reaction type, multistage impulse type.

The following gives the classification of a few well known turbines:

Impulse Type	De Laval		Single Stage
	Curtiss	Nozzles for Expansion	Multi Stage
	Kerr		
	Rateau		
	Hamilton-Holzworth		
Reaction Type	Parsons		
	Westinghouse-Parsons		
	Allis-Chalmers		

A brief examination into the theory of the turbines, without going into the question of thermodynamics will help to an understanding of the action of the different types of machines.

Steam under pressure possesses potential energy but has no motion unless allowed to expand. By expansion this potential energy may be changed into kinetic energy, or velocity, this energy being expended in overcoming the resistance of the air or whatever opposes the increase in volume of the steam. The energy developed depends almost entirely upon the number of expansions and not upon the pressure at which these expansions take place, i. e., as much energy is released in expanding steam from 2 lb. to 1 lb. pressure as between 150 lb. and 75 lb. pressure.

The energy of a moving jet of steam is expressed in terms of its weight and velocity by the following formula: $E = \frac{W V^2}{2g}$

It is therefore seen that the velocity is the prime factor to be considered, provided, of course, that a properly designed machine can be made to utilize the energy so obtained.

If V_1 represents the initial velocity of the steam as it impinges on a turbine bucket and V_2 its absolute velocity at outflow, the energy given to the turbine wheel would be per pound of steam, $\frac{V_1^2 - V_2^2}{2g}$, and the impulse efficiency of the machine would be $\frac{V_1^2 - V_2^2}{V_1^2}$.

Consider a pound of steam having a velocity of 2000 feet per second as represented by a perfectly elastic ball, and the bucket of a turbine wheel, having a peripheral velocity of 1000 feet per second as represented by a moving plane, much larger than the ball and moving in the same direction, with its plane surface at right angles to the direction of motion. Neglect all frictional losses. The velocity of the ball relative to the plane will then be 1000 feet per second. When it overtakes the plane it will rebound with a velocity relative to the plane of 1000 feet per second. But as the plane still continues at about its initial speed, being much larger than the ball, this means that the absolute velocity of the ball, i. e., its velocity relative to the earth, is zero, so the kinetic energy is 0, all that it had having been given to the plane. This means that the impulse efficiency as represented by the formulae $\frac{V_1^2 - V_2^2}{V_1^2}$ is 100 per cent, as V_2 is 0. In other words, to obtain the best efficiency the bucket speed should be nearly equal to one-half of the initial steam velocity.

The initial velocity of the steam is almost entirely dependent upon the design of the nozzle. With a plane orifice a velocity of about 1500 feet per second is possible, with steam at 150 lb. pressure on one side and 2 lb. absolute pressure on the other. This velocity is almost independent of the ratio of the two pressures, provided this ratio is as low as 58 per cent. In other words, where in a multistage machine a drop in pressure of less than 42 per cent is only required, a plane orifice might be used. With a well designed nozzle, such as is used on the De Laval turbine, a velocity between these same pressures of 4010 feet per second is obtained.

In actual practice it has not been found practicable to obtain a bucket velocity of one-half the steam velocity, partially because the nozzles have to be placed at various angles to the buckets, and partly because of other constructional difficulties.

Consider the elementary theory of a De Laval turbine as representing the single stage impulse type of wheel, Fig 1.

Let the crescents represent the cross-section of the blades of the turbine and V_1 be the initial velocity of the steam, Y the bucket speed, and a the angle

of the nozzles to the plane of the bucket wheel. Then the resultant of V_1 and Y is N, which represents the relative entrance velocity of the steam. Neglecting losses the steam would leave the bucket at the same speed, represented by v_2, and by the above method of resolving the forces the absolute velocity would be V_2. Energy developed $= \frac{V_1^2 - V_2^2}{V_1^2}$

The blades of the wheel should be curved so that v_1 is tangential to it, and so prevent any sudden shock

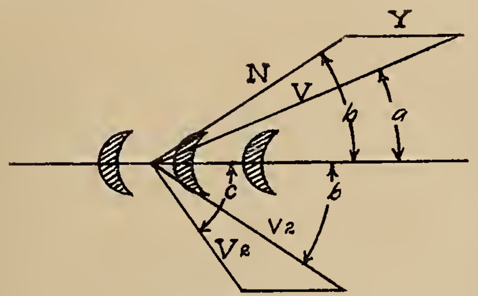


Fig. 1.

due to change in direction of the steam. The exit angle (b), is generally made to agree with the entrance. A consideration of the frictional losses would change the relationship and value of the forces of the above diagram slightly.

The De Laval turbine as representing the single stage machine consists primarily of the nozzle or nozzles in which the steam is expanded to exhaust pressure in one step. This steam is blown directly onto a single wheel to which it imparts a percentage of its energy, from which in turn it is conveyed to the driven apparatus. The nozzle is of the best design, and after passing the smallest section diverges toward the exit, so as to allow for increased volume of steam due to expansion, and so as to use this energy of expansion in increasing the velocity of the steam in the direction of flow. Otherwise this energy would be dissipated in all directions while expanding. For the same reason the discharge end of the nozzle is placed closely against the wheel. Even in the little space allowed, eddy currents are set up which reduce the efficiency. This nozzle is generally set at about 20 degrees with the plane of the turbine wheel and at the side of the same. The nozzles can generally be opened or closed by hand, and the number of nozzles varies with the conditions of operation and power requirements. The wheel itself consists of a solid disc on the periphery of which are mounted the blades or buckets. These latter are crescent shaped in cross-section and are set in milled grooves on the wheel and calked into place. They do not require changing for variations in pressure, vacuum, or superheat, but the nozzles are designed for the conditions of operation and vary in number and size with the above mentioned steam characteristics.

The wheel is mounted on a flexible shaft which allows it to rotate about its gravity center instead of being forced to keep its geometric center.

A fly ball governor actuating a throttle valve through a system of levers is used for regulation. Owing to the small diameter of the wheels used in this type of turbine, the peripheral velocity required, which for maximum efficiency must approach one-half of entire steam velocity, means a very high rotative speed. This varies with different machines from 8000 to 30,000 r.p.m. It is obvious from this that, as before stated, some means of reducing this speed must be used in practical applications of the turbine. In the De Laval machine, gears of very small pitch and specially designed and accurately cut teeth are used. The makers claim that with their gear which gives a reduction of about 10 to 1, there is a loss of only from 2 to 3 per cent when the machine is in good condition.

Now let us consider other methods by which the rotative speed may be reduced to a workable point.

1. The diameter of the wheel might be increased so as to get the required peripheral velocity without excessive rotative speed.

2. The steam might be partially expanded in a set of nozzles and the energy absorbed by a turbine wheel, after which it might be expanded to a still lower pressure and again used, etc., this process being repeated as many times as required. Obviously as $E = MV^2$ a reduction of the velocity by one-half would mean that only one-fourth of the energy would be developed, or in other words, a four-stage machine would be required to reduce the rotative speed 50 per cent, and the reduction is proportional to the square root of the number of stages.

3. A bucket wheel might be designed so as to absorb only part of the energy developed in the nozzle, and then a second wheel placed so as to absorb a second portion, etc. In this way the reduction in speed would be proportional to the number of wheels. The multi stage impulse machine employs one or more of these methods of reduction in order to obtain large power machines with moderate shaft speed.

The simple theory of a turbine is shown in Fig. 2.

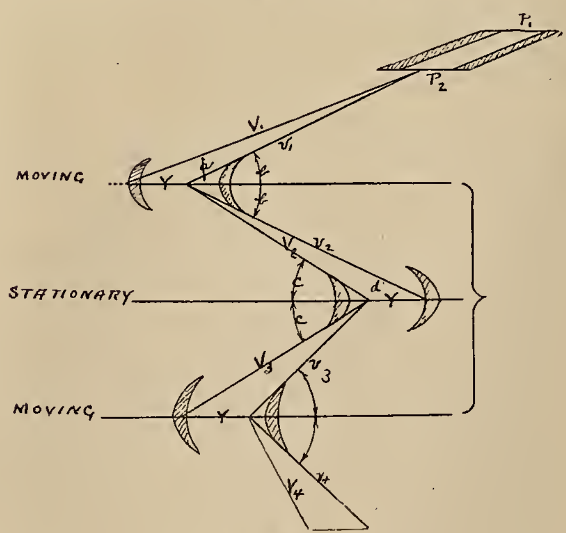


Fig. 2.

Steam is expanded in nozzle N from pressure P_1 to pressure P_2, this latter pressure being determined by the number of stages which the machine is to have, and obtains an initial velocity V_1, while Y represents the velocity of a turbine blade or bucket. The resultant of V_1 and Y or v_1 is the velocity of the steam relative to the bucket and b is the correct entrance angle for the bucket to prevent a shock when the steam enters the same. Neglecting losses and making the exit angle equal to the entrance angle v_2 (exit velocity) $= v_1$. The resultant of this with Y gives the absolute

exit velocity v_2. As the second row of buckets is merely used for redirecting the steam and is stationary the correct entrance angle would be c and not d. In the same way V_2 is taken as equal to V and the resultant v_3 gives the correct entrance angle for the second set of moving buckets.

$$\frac{V_1^2 - V_2^2}{V_1^2}$$

$$\text{Energy absorbed per lb. of steam} = \frac{V_1^2 - V_2^2}{2g}$$

In any one stage the volume of the steam is supposed to remain the same, but as its velocity is reduced during its passage through the stage, the space between the blades must increase. This is generally done by increasing the length and decreasing the thickness of the blades while keeping the pitch constant.

As a general rule all kinetic energy generated by the first set of nozzles is supposed to be absorbed by the bucket wheels in that stage. If, however, the steam leaving the last wheel still has absolute velocity, this will be converted into heat by the impact due to its being brought to rest by the diaphragm between the two stages.

In the Curtis turbine, after passing through the first stage as above described, the steam is again caused to expand through another set of nozzles into a second chamber, called the second stage, where the same process of absorbing the kinetic energy generated in the nozzles is carried on. The nozzles, space between blades, etc., of course have to be larger than those of the first stage so as to accommodate the increased volume of the steam. In some machines this expansion is carried on through a third and fourth stage. Fig. 4 gives a clear view of the steam end of a Curtis turbine as representing the multistage impulse type.

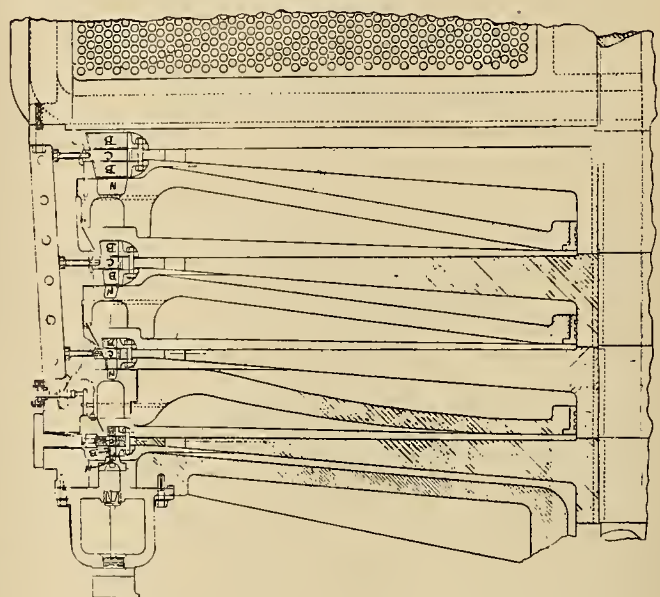
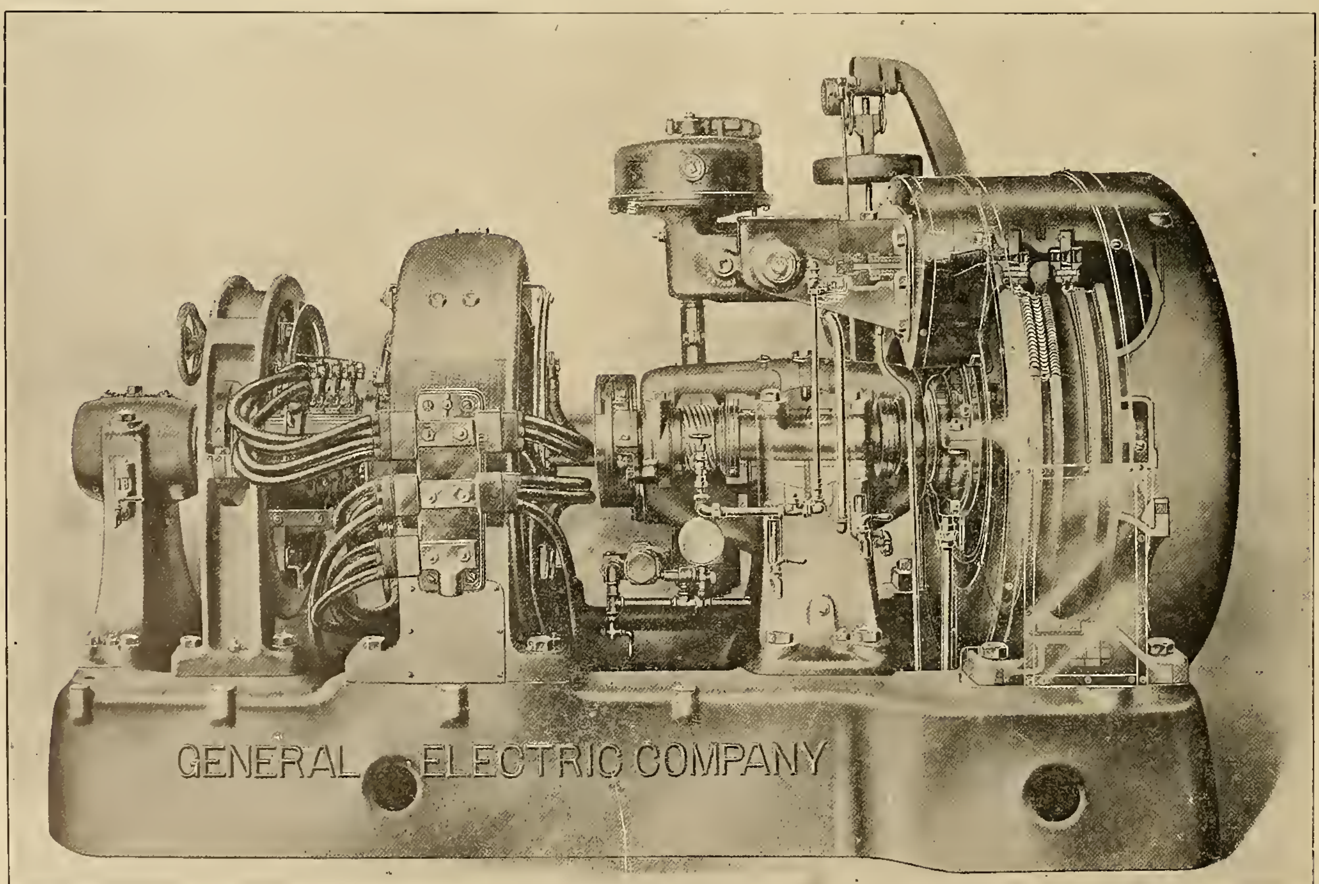


Fig. 4. Assembly of 5000 kw. four-stage turbine.

This cut shows only the steam end. The vertical machine has the generator directly above the steam end, both the revolving field of the generator and the revolving buckets of the steam turbine being on the same shaft. The turbine being vertical, the thrust and weight of the machine is taken by the lower or step



Phantom View of Curtis Steam Turbine.

bearing. This bearing is in two parts, and through the lower one oil is forced at a high pressure. This causes the parts to separate and allows the oil to flow out between them, so that the whole weight of the machine is carried on a film of oil. In some cases water is used in place of oil. The cut plainly shows the increase in size of the nozzles N and buckets B; this allows for the increased volume of steam due to its expansion. It will be noted that one revolving wheel carries two revolving buckets. These are milled in bronze or steel and bolted to the outer edge of the wheel, one on each side, and so arranged that the stationary buckets, C, which are bolted to the outside casing of the machine comes between them.

The nozzles are rectangular in shape and at their large or inner end are only separated by very thin partitions, so that the steam enters in practically a continuous belt. The admission valves are controlled by a governor and are so arranged as to open successively. There is one valve for each nozzle and they may be operated mechanically, direct from the governor, electrically through contacts and solonoids operated by the governor, or hydraulically, by an oil cylinder controlled by the governor. In each succeeding stage the number and size of the nozzles is increased to allow for increased steam volume, until, in a four stage machine they extend, in the last stage, all around the circumference of the wheel. Except in the first stage there is no nozzle control, those in the other stages being open all the time. Carbon packing rings are used around the shaft at each end of the steam cylinder so as to prevent leakage.

The Curtis machines are also built in a horizontal form. The small machines have been built this way for a long time, and during the last year the design of the larger ones has been carried out. These, I understand, are of higher speed than the older vertical machines, and the economy obtained is claimed to be considerably greater than anything previously given by any turbine.

With this machine the axial clearances require close adjustment, but the radial clearances may be large.

In a so-called reaction type of machine, of which the Westinghouse-Parsons and Allis-Chalmers are the best known in this district, the flow of steam is continuous from the inlet to the exhaust. In the impulse machine of the compound or multistage type, as exemplified by the Curtis turbine, the various expansions required take place in nozzles, each stage of the machine being separated so that the bucket wheels rotate in a chamber containing steam at a constant density. In the reaction type—all of which are multistage—no nozzles as such are used, the expansion being effected in the moving and stationary buckets of the machine. The rotor in these machines consists of a large barrel, to the outside edge of which is attached the turbine blades. The stator is of cast iron and to its inside surface is fastened the stationary blades, so arranged as to alternate with the moving blades. The whole expansion takes place in the annular space between the stator and rotor, which in reality resembles a divergent nozzle, this space and also the blades being increased in size toward the exhaust end so as to allow for the increased volume of steam due to expansion. Each pair of blades (1 moving and 1 stationary) is called a stage, and in large machines as many as 100 stages are some times employed. This, of course, means a low velocity of steam, as the expansion in each case is slight. In fact, it varies from 150 feet per sec. at high pressure end to from 600 to 800 ft. per sec. at the low pressure end.

The action, briefly, is as follows: Steam enters the first set of stationary blades and is expanded somewhat. With the resulting velocity it impinges on the moving bucket and imparts energy to the same. On leaving this moving bucket the steam is again expanded and thus has a reactive effect on the bucket, in addition to the impulse imparted by the entering steam. This action is continued until the steam reaches exhaust pressure.

The elementary theory is as follows, Fig. 5, the same notation being used as previously.

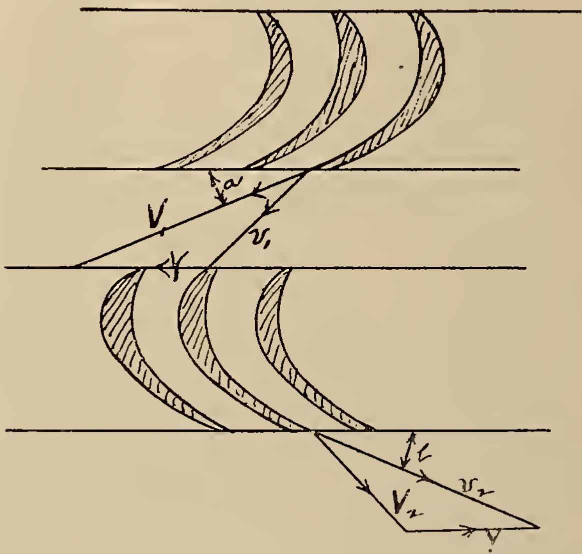


Fig. 5.

Steam receives an initial velocity, V_1 from expansions in the stationary vanes or buckets, which gives a relative velocity, v_1 as resultant of V_1 and Y and shows the correct entrance angle to moving buckets. In passing through the moving buckets the steam is still further expanded and leaves the same with a relative velocity v_2 which is greater than v_1 and which resolved with its component Y gives V_2 as absolute velocity.

The energy developed in the stationary blade for one pound of steam is $\frac{V_1^2}{2g}$. That in the moving blade (without expansion here v_2 would equal v_1) is $\frac{V_2^2 - v_1^2}{2g}$; so the total for one stage would be $\frac{V_1^2 + v_2^2 - v_1^2}{2g}$, while for the total energy absorbed we would have $\frac{V_1^2 + v_2^2 - v_1^2 - V_2^2}{2g}$, and so on through all the various stages.

The accompanying cut of a Westinghouse-Parsons turbine shows clearly the construction of the machine This is given to illustrate a reaction type of turbine. Other machines of this type, while different in their method of construction and in their general details,

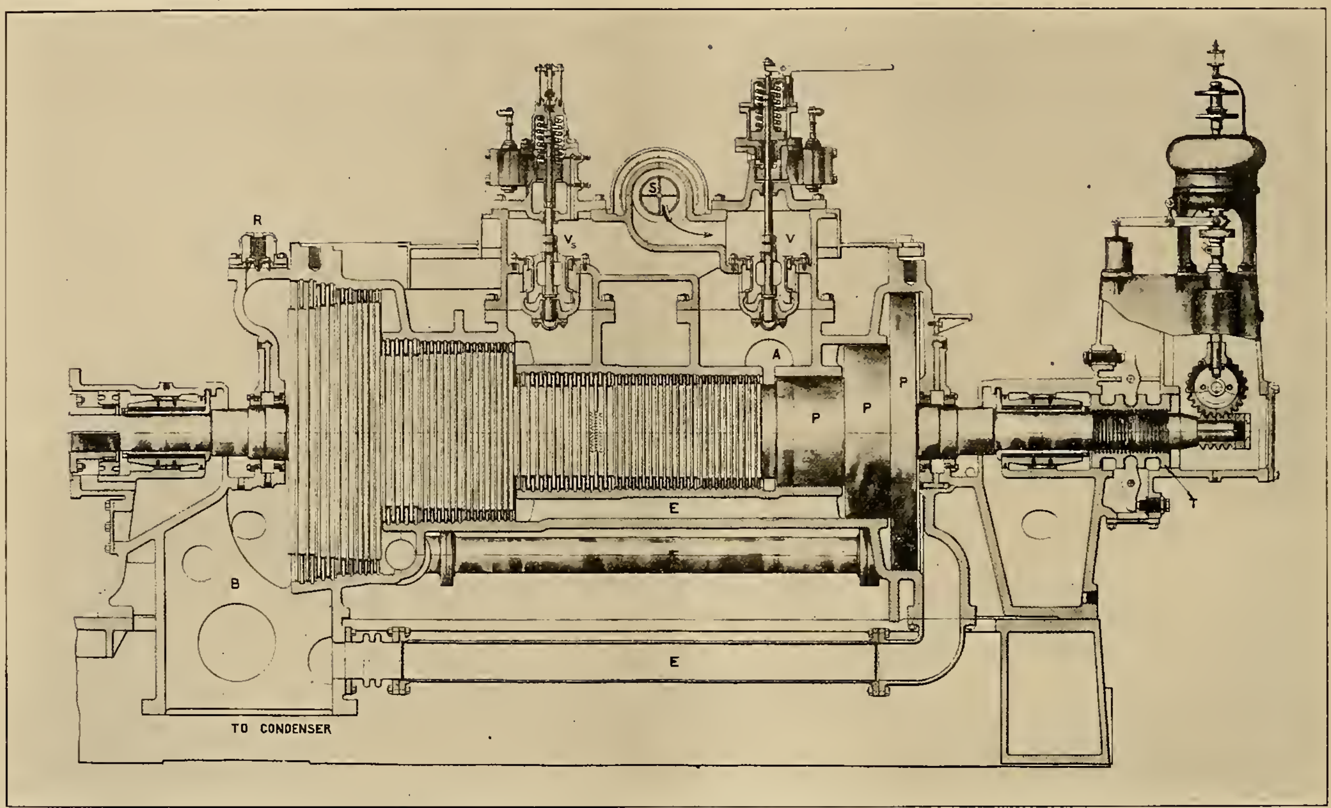
employ the steam in practically the same manner. Briefly, steam enters the turbine through the valves V, which are operated by a small pilot valve, which is in turn controlled by the governor. The valves are of the poppet variety and the steam is admitted in puffs, the amount being determined by the length of time the valve stays open. The steam enters the annular space between rotor and stator at A, and is finally discharged from this space into B. The balance pistons P are each of such diameter as to exactly balance by means of the passages E, the axial thrust of the steam against its corresponding drum or blades.

In the illustration the increase in blade surface to allow for increased steam volume is clearly shown. The varying diameters of the drum or rotor are for the same purpose, and are merely mechanical conveniences. Provision for this increased volume might be made with the drum all of one diameter, but with high pressures, the blades at the entrance end would be very small and at the exit end very large. By varying the diameter, the blades are kept at a convenient size and the number of sizes of blades reduced considerably. In this machine water glands are provided at each end of the shaft so as to prevent leakage. Radial clearances should be small, but axial clearances do not require such close adjustment.

Double flow turbines are now being produced by manufacturers of the reaction machines. In these machines the steam flows both ways from the center, the rotor being in reality of such a shape as would obtain if two rotors similar to those in the illustration were placed with their small ends together. This style of construction does away with the balancing pistons. I am informed that the Westinghouse people are about to bring out a small turbine. This, however, is an impulse wheel, and so not of the same design as their large machines. In fact, I believe that the reaction type of machine has not been found suitable for small powers.

The advantages of turbines as compared with reciprocating engines may be enumerated roughly as follows:

1. Reduction in space occupied and smaller foundations.
2. Saving in oil.
3. Absence of oil in condensed steam.
4. Less vibration.
5. Regulation.
6. Simplicity.
7. Less drop in economy due to age and inefficiency of operators.
8. Economy, especially with load fluctuating heavily.



Longitudinal Section of a Typical Westinghouse-Parsons Steam Turbine.

Let us now consider these points separately and briefly.

1. Consider the smaller units, such as are generally met with in this district, i. e., from 500 to 3000 kw. capacity. At Leadville there is a 1500 kw. Curtis turbine unit set on concrete foundations. This requires 101 sq. ft. of floor space and its foundations contain 25 cu. yds. of concrete. The Denver Gas & Electric Company have in their West Side stations two Filer-Stovell cross compound Corliss stations driven units, the same capacity, each of which occupy 682 sq. ft. floor space and have 153 cubic yards of concrete in their foundations. The three-cylinder vertical compound engines of the New York Edison type probably give the best space economy of any type large

reciprocating unit made, but these occupy about twice the area of a horizontal turbine and from 60 to 70 per cent more than a vertical turbine. The smaller weight and absence of vibration with turbines means a greater possible reduction in the cost and size of foundations when compared with engines than is denoted by the mere relative space economies. The financial benefit of this space economy is readily seen. Consider a 4500 kw. plant containing three 1500 kw. units and using the figures above given from actual conditions. The floor space required for a turbine plant would be 1743 sq. ft. less than for engines, assuming the same amount of free space and the same area for auxiliaries and boilers. An average brick or concrete power plant of this size costs, roughly, from 12 to 14 cents per cu. ft. With a one-story plant about 30 ft. in height the above saving in space means a reduction of $6798 in building cost. The saving in foundations at $10.00 per cu. yd. would amount to $3,840.00 for the three machines. In addition to this we must add 12 per cent for saving in depreciation, interest, taxes and insurance, which give a grand total of $11,914, due entirely to the space economy given by turbine units.

2 and 3. Saving in oil, etc.: There being no internal lubrication and many less bearings requiring oil than on a reciprocating plant, this saving is considerable. The absence of oil in steam means that all condensed steam can be returned direct to the boilers, which means a large saving in many plants, not only in fuel, but in boiler and economizer cleaning, etc., and this without fears regarding the bagging of tubes, cleanliness of oil filters, etc. Mr. H. G. Stott, who is better able to speak on these matters than most engineers, gives the saving due to lubrication alone as being in the ratio of 1.77 for the reciprocating engine to .35 for the turbine, or about 80 per cent.

4. Less Vibration: As explained under No. 1, this factor affects materially the size and cost of foundations, even when the same material is used. Another factor must be considered in this relation also, i. e., this point allows the use of other and cheaper materials for foundations. Some years ago in a Leadville plant it was necessary to increase the capacity quickly. A 500 kw. Curtis turbine was purchased in Denver and shipped to Leadville, where it was set temporarily on a foundation built entirely of 12-inch x 12-inch timbers bolted together, so as to raise the base of the turbine about 8 feet from the basement floor. The bottom of this wooden foundation rested directly on the floor, which was not altered. In this condition the turbine was put in operation until a larger unit should be received and erected. That machine is still running today as originally set up, and at 1800 r.p.m. it is possible to balance a dollar on the edge of the turbine casing.

In many modern installations the foundations consist of steel beams with concrete arches between and resting directly on the floor, the basement below the turbine being used for condenser, etc., instead of being occupied by heavy concrete foundations, thus still further increasing the space economy.

5. Regulation: Reciprocating engines have to be provided with heavy fly wheels to reduce the variations in each revolution, due to lack of uniformity in angular effort. The turbine with purely rotative motion has a uniform angular velocity and an exact regulation is obtained. In fact, most turbines show only from 1 to 2 per cent variation from no load to 50 per cent overload.

6. Simplicity: There are, it is true, many more parts in a large turbine than in an engine, but by far the greater number of these—the buckets—are all used to form one moving part—the rotor—so that the turbine as a whole is much the simpler of the two. It has far fewer moving parts, and this with the absence of stuffing boxes, etc., lends much to the simplicity of operation and maintenance.

7. One point in favor of turbines that is often overlooked is their fixed economy. The turbine economy is established by the design to a great extent.. For instance, with given steam conditions, the nozzles, staging, blading, etc., are designed for certain results, which are in no way dependent on adjustment after the machine is turned out. Regarding wear, it seems as though this would only affect the efficiency when it causes a change in the clearance spaces as affecting steam leakage or when changing the shape of the blades or buckets. Among the first designs some slight wear took place in the latter, but in later designs this has been practically overcome, especially where dry or superheated steam is used. Prof. Carpenter reports testing a machine that showed absolutely no difference in economy after three years' continuous usage, and this has been found the case with other machines even after much longer usage.

Reciprocating engines, especially in the smaller types, show rapidly increasing losses due to wear, and in all sizes the economy is due to adjustment. Engine economy should be maintained, but in most small plants and in some larger ones, the engines, as long as they run, are rarely examined or tested, and are often running way below their best economy—eccentrics slip, packing becomes loose and leaky, adjustment becomes bad, valves worn and leaky, alignment poor, etc., and heavy losses ensue, all from lack of attention. The turbine having simple rotative effort and being of fixed designed economy is not subject to these troubles, and surely this is an immense advantage.

8. The economy of a prime mover depends but partly on the pounds of fuel per h.p. hr. The cost of maintenance and operation must also be considered, and this it seems is decidedly in favor of the turbine, partly due to its simplicity and the absence of losses due to adjustment and partly due to saving in packing, oil, waste, etc. For some time it was acknowledged that the steam engine was more economical in fuel consumption under its best conditions of operation than the steam turbine, but during the last year or so this condition has gradually changed until, if anything, the palm lies with the turbine. It is hard to get test results for comparison without making some theoretical correction necessary to get exactly similar conditions. The best turbine results seem to compare favorably with those obtained by the best engines when under test, while in actual practice, when test conditions often do not exist, the turbines come far closer to keeping their economy than do the engines, as above explained. Another

point in favor of the turbine in this connection is the flatness of the economy curve from half load to a large overload. On the accompanying curve sheet, Fig. 6, are stated the results of two tests, one on a 5000 kw. Curtis turbine and one on a 5000 kw. four-cylinder compound engine in the plant of the New York Interborough Metropolitan Company (A. I. E.

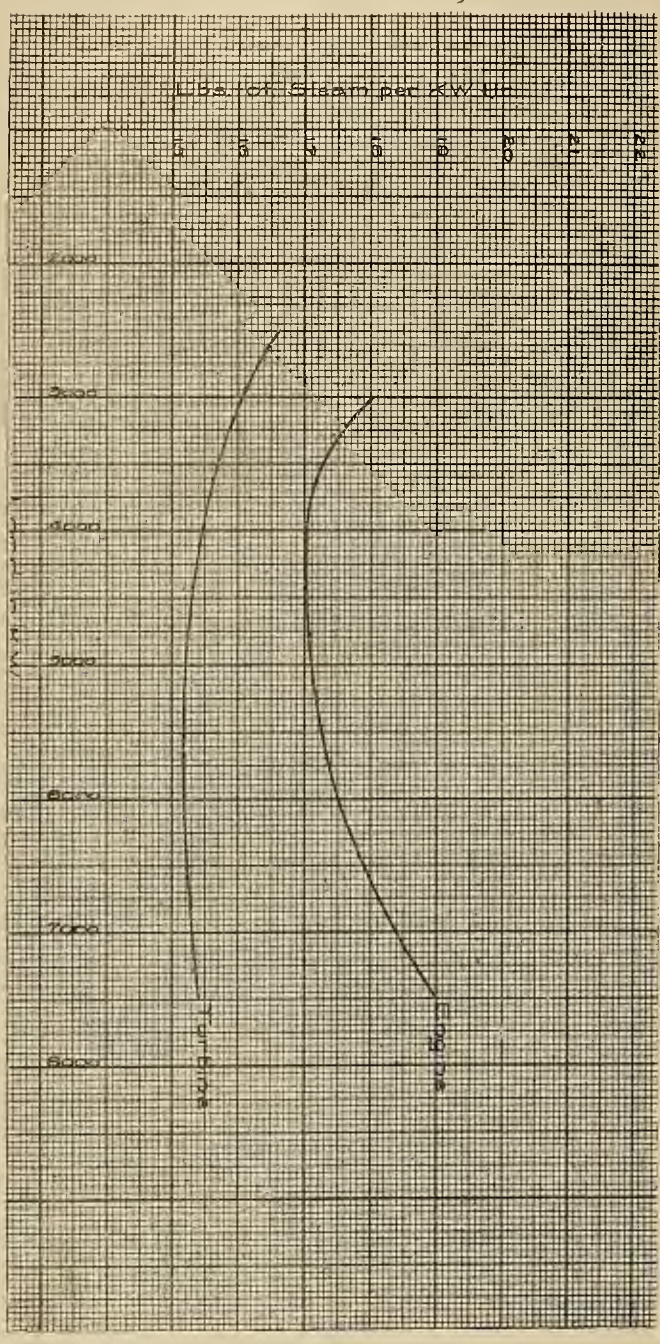


Fig. 6.

E. 1906.) Both are reduced to the same working conditions. While the turbine shows marked advantage in the steam consumption at all points, this is especially apparent at both ends of the curve. In other words, it is necessary with an engine to operate within 20 per cent of rated load if economy is expected, while with a turbine this variation can extend safely from one-half load to 75 per cent overload. In electrical work or any other class of plant where variable loads are expected, this fact gives an immense advantage to the turbine. This not only effects an economy, but increases the peak capacity very materially.

The cost of turbines as compared with engines is hard to give, owing to the difference in the ratings employed. I have obtained at various times figures on plant cost, which may be interesting, however.

The following bids were made on a contract requiring several 100 h.p. and 150 h.p. high speed units. The bids include the auxiliaries:

Curtis turbines	$17,360
De Laval turbines	17,000
Terry turbines	17,985
Skinner engines	21,478
Harrisburg engines	24,000

This seems to show that with small turbines and engines the cost of the latter is from 20 to 35 per cent higher than the former.

The curves in Fig. 7 show the cost of various high speed engines as compared with those of a Kerr turbine. These figures were given me by the various agents and should be correct. This shows that above 150 h.p. the turbine prices are very attractive when compared with those of the better class engines and that they become more and more so as the size of the unit increases. Some prices which I have on larger turbine units show a cost of:

$20.00 per kw. for 500 kw. unit.
$17.00 " " " 1,000 " "
$15.50 " " " 4,000 " "

Superheated steam is coming into greater use each year in connection with reciprocating engines. In this country more than 200 to 250 degrees F. of superheat is rarely used, but in Europe the temperatures are higher. It is a question whether these highest temperatures pay. The actual reduction in steam consumption may be offset by maintenance, cost of operation, etc.

With high pressures and high superheats considerable difficulty in maintaining the superheater is experienced. To the cost of this maintenance must be added the cost of the fuel required to give the extra heat to the steam, and any extra expense from trouble with the prime mover due to the use of this steam. Sometimes difficulty is experienced with cylinder lubrication, warped valves and unequal expansion due to high steam temperatures. The principal gain from this source with reciprocating engines is caused by the partial elimination of cylinder condensation due to the heat above the saturation point and also to the lower conductivity of superheated steam. With a turbine, there being but little cylinder condensation, the principal gains from superheating are from the reduction in windage or wheel friction, and in the steam friction. Of course this is in addition to the energy obtained from the extra heat of the steam, while there being no interior lubrication or valves, the difficulties above mentioned in connection with reciprocating engines are not experienced with turbines.

A gain of one per cent in the steam economy of a high speed reciprocating engine is obtained for each ten to twenty degrees increase in superheat, while turbines give the same increase in economy on about twelve degrees increase in superheat.

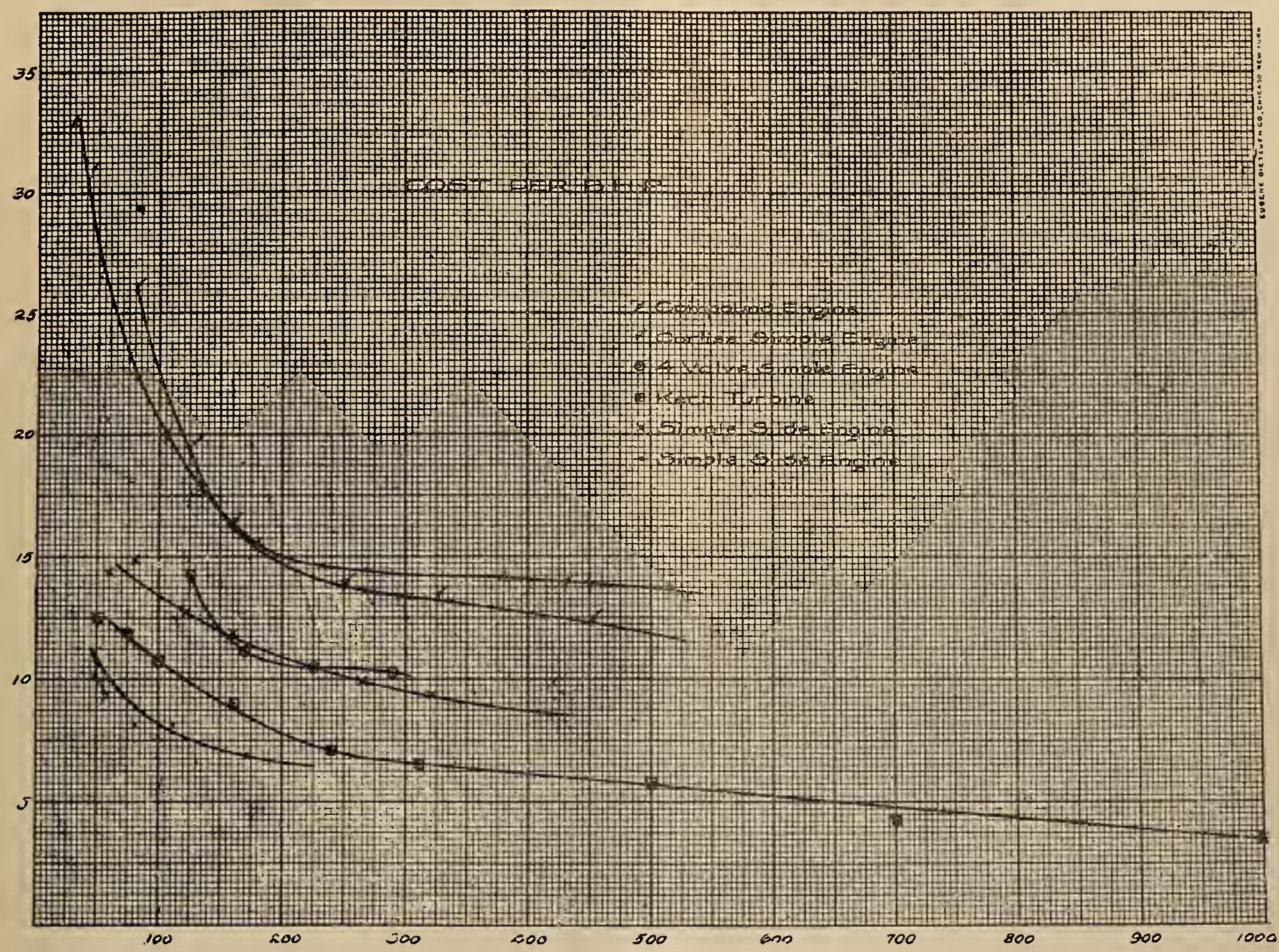


Fig. 7

Most engines show a rapidly decreasing gain per inch of vacuum above 22 or 23-inch (30-inch barometer), and what gain there is is due principally to a decrease in back pressure. Turbines, on the contrary, continue to show substantial gains up to the practical limit of vacuum. It is sometimes argued that the first cost and cost of maintenance of condensing apparatus capable of giving the high vacuums used by turbines offsets the gains.

There is, without doubt, a considerable increase in this first cost, but it can by no means offset a gain on consumption of 3 to 5 per cent per inch of vacuum which is obtained by the turbine. Many turbines are now built to set directly on top of the condenser, or at least so that there are very short connections between, so reducing the leakage possibilities to a minimum. There is even then, however, more necessity for tight joints and good operation than with a reciprocating unit, as any failure in this line with a turbine means much greater loss, at low back pressures especially, than it would with a reciprocating unit.

One branch of the turbine industry that is being pushed very heavily at present, is the building of non-condensing machines especially adapted to high speed work with moderate powers, such as the driving of high pressure blowers, centrifugal pumps, and small generators. The small space, and the simplicity, together with reliability of operation and small cost of maintenance, is fast giving a big demand for these machines. Those that have obtained the most prominence are the machines manufactured by the

De Laval Steam Turbine Co.,
General Electric Co.,
Terry Steam Turbine Co.,
Kerr Turbine Co.,

although several other makes are in the market.

The De Laval and Curtis machines have been briefly described.

The Terry turbine is what might be called a single stage impulse machine with multiple bucket extraction. The steam is expanded through a nozzle and after acting on the wheel is re-directed through 180 degrees and again acts on the wheel, this process being repeated until all velocity or energy has been extracted.

The Kerr turbine is becoming well known in the West and gradually coming into more general use. This machine is of the multistage impulse type, with several velocity extractions, but only one per stage. The nozzles are converging and blow the steam onto buckets similar to the Pelton water wheel bucket.

While I have referred to these small machines as non-condensing, they are also used with condensers and give under those conditions largely increased economy.

Low Pressure Turbines.

One of the reasons for the slow economical development of the steam engine during the last few years, has been the inability of finding practical means to adjust this machine to properly utilize to the full extent the energy possessed by steam at pressures well below the atmospheric line.

A pound of dry steam expanded adiabatically from 155 lb. absolute pressure to 15 lb. absolute gives up in work about 176 B.t.u., while between 15 absolute and 1 lb. absolute 170 B.t.u. would be released, and during the whole expansion the volume of steam has increased roughly 124 times; while if this steam were expanded to ½ lb. absolute pressure its volume would be again nearly doubled. In fact, 1 pound of steam would occupy at ½ lb. absolute pressure about 640 cu. ft. of space.

The amount of energy obtainable from a pound of steam depends on the number of expansions possible in the apparatus using it, and cylinders and valve openings of sufficient size to accommodate the rapid increase in volume at very low pressures cannot be profitably used. Even if a machine of this kind were designed and built so as to allow of expansion of the steam to ½ lb. absolute, there would be no economy gained. The cylinder condensation would increase so rapidly that it would probably more than offset any gain due to expansion. In fact, most condensing engines open to exhaust at about 6 lb. absolute pressure. It has been proven conclusively by tests that there is but very little gain with a reciprocating engine due to an increase in vacuum above 22 inches (30 inches barometer) and that a maximum is practically reached at 26 inches. A low pressure turbine, however, overcomes these difficulties. It can be built with areas in nozzles or between blades sufficient to accommodate the large volume required at very low pressures. There is no dropping off in the increase of economy caused by a corresponding increase in vacuum, even to the very lowest pressure, as with a well lagged casing, cylinder condensation is practically absent. Another point in favor of the low pressure turbine is the fact that the windage or frictional losses are less with low pressure steam than with high, due to the decreased density of steam.

Briefly, there is practically as much energy in a pound of steam at 150 lb. absolute below the atmosphereic line as above it, but the reciprocating engine cannot use it to advantage, while the turbine built for the purpose can.

A condensing engine rarely shows more than from 25 to 30 per cent gain over a non-condensing condition, and even less where the engine is overloaded. An exhaust turbine used in connection with a non-condensing engine will give an increased output of 50 per cent over that which could be obtained by changing the engine from non-condensing to condensing, or from 75 to 100 per cent over non-condensing conditions.

The low pressure turbine can be advantageously applied to any plant where reciprocating engines are used, either condensing or non-condensing, and by showing a decidedly increased economy naturally largely increases the peak capacity of the plant without any alteration in the size of boiler plant.

A large number of plants with reciprocating engines are run non-condensing, due to the low cost of coal obtainable or to the absence of a good supply of condensing water. This is certainly justifiable where the interest on first cost of condensing apparatus, etc., plus the cost of maintenance, is such as to offset the saving due to condensing. There are, however, very few, if any, cases where this condition could exist when compared with the saving given by an exhaust turbine.

About ten years ago one of the large plants of Colorado found that their capacity was too limited to meet their demands. The plants under their control and which fed into common mains, consisted of a hydroelectric plant of 2250 kw. capacity, a small steam plant of about 1000 kw. and a larger steam plant of 2250 kw. rated capacity. Owing to location, quantity of water available, etc., it was not deemed advisable to alter either of the first two mentioned plants, but it was decided to make all additions to the main or 2250 kw. steam plant.

The equipment here consisted of three 1000 h.p. Corliss engines, each direct connected to a 750 kw. generator and run non-condensing, so that the logical manner of increasing the peak capacity was by the installation of an exhaust turbine between the engine and a new condenser. This was done; a Westinghouse low pressure turbine of 1500 kw. capacity being installed and a cooling tower with pond being built. This turbine was supposed to take the exhaust from the two engines, but it was found that owing to overload capacity it could utilize economically even more than this. The following figures give the really startling results obtained:

When the engines were first installed careful tests were made on them, the best results obtained being 32 lb. of steam per kw. hr. Later, the chief engineer of the plant made some very careful adjustments and thinks the steam consumption was decreased to about 31 lb. per kw. hr. Compare this with the results obtained on a careful test made later under ordinary running conditions on two of the engines running in conjunction with the Westinghouse turbine, and which gave the following results:

Duration of test	8 hours
Kw. hrs. generated	16,730
Average steam pressure	150 gauge
Average vacuum	21.6 inches
Average back pressure (exhaust main)	.3 lbs.
Dry steam per kw. hr.	17.67 lbs.

I do not know what percentage of this load was given by the turbine, but judge from the results obtained that it would be approximately 70 per cent of that from the two engines, while the mere installation of a condenser alone would have merely given an increase of about 25 per cent. The actual monthly running cost for generation only, before and after the turbine installation, is also instructive. In making this comparison, periods of time have been chosen during which practically the same rate of generation was being carried on, so that a very fair measure of the success obtained is given. For September, November and December, 1908, (before the turbine was in-

stalled) the monthly kw. output agrees very closely with that of January, February and December of 1909, (after the installation), and so these months are compared in the following table. On most of the other months of 1909 the generation at this steam plant was low, owing to their being an abundance of water for use at the hydro plant.

Month	Sept. '08	Oct., '08	Nov. '08	Jan. '09	Feb. '09	Oct. '09
Total kw.-hr	1,441,710	1,558,940	1,445,560	1,577,280	1,417,670	1,421,430
Cost per kw.-hour.						
Fuel,	$.004650	$.004780	$.005200	$.0034650	$.0032780	$.0030600
Boiler Room Labor,	.000930	.000850	.000960	.0007025	.0007600	.0004850
Engine Room Labor,	.000407	.000381	.000408	.0004267	.0004690	.0004830
Water,	.000160	.000144	.000155	.0001436	.0001587	.0001609
Oil, Waste, etc.,	.000029	.000098	.000100	.0001001	.0000930	.0000836
Repairs, Steam,	.000309	.000363	.000289	.0003190	.0001962	.0000879
Repairs, Electrical,	.000012	.000028	.000052	.0000084	.0000107	.0001408
General Labor and Repairs,	.000013	.000027	.000391	.0001781	.0000743	.0002300
Sundry Expenses and Supplies,	.000127	.000102	.000088	.0001001	.0002832	
Condensing Apparatus Repairs,				.0000430	.0000158	0000000
Total,	.006637	006673	007643	0054865	00534	00474

I am assured by those in charge of this plant that the month of December more closely represents their generation costs than do those of January and February, 1909, as the last two named months were the first two of operation with the turbine and were before the best method of operation had been decided upon.

In comparison there is one point to be mentioned, i. e., the condensing apparatus is electrically operated, and while this table gives the actual cost of producing a kw. hr. (the current used for condensing being in the total) it would be best in studying the result to remember that the cost of this condensing apparatus current would add about 3-10 mills to the figures given.

It will be seen that there is a practical reduction in nearly every item which goes to make up the table given. Owing to the addition of the extra machinery it might be thought that the cost of maintenance would be materially increased. This, however, is not the case —in fact, the total average monthly expense for maintenance of steam apparatus has decreased since this turbine was added. This is probably due to the decrease in load on the old machines, which were previously overloaded, and to the fact that enough capacity is now installed to enable the plant to be overhauled occasionally and kept in better shape.

In the plant just discussed an induction heater is placed between the engines and the turbine and by this means the feed water is kept nearly as hot as before and apparently with little loss to the turbine. This was advisable owing to the condenser apparatus being electrically driven. The exhaust pipe between engines and turbine is generally kept at about ½ lb. above atmosphere. This is good practice, as it prevents leakage of air into the pipe. Although the turbine is provided with a governor, this is not used, but the regulation is carried by the engines, the turbine merely using the steam given to it.

Lately this same company have installed an Allis-Chalmers turbine of 1500 kw. capacity, so arranged that it can be run condensing direct or can be used with the exhaust turbine. This latter machine has also done well. In an eight-hour test run, under ordinary daily conditions with about 20-in. vacuum, and with a load varying from 820 kw. to 2370 kw., or from about one-half load to nearly 70 per cent overload, a steam consumption of about 21 lb. of steam per kw. hr. was obtained. This fact again emphasizes the importance of steam turbines over reciprocating engines where a very variable load is carried.

There is another field for this machine that should be mentioned, i. e., in plants using reciprocating engines intermittently, such as rolling mills, hoisting plants, etc. In cases like this a steam regenerator receives the exhaust from the engines and supplies it to the low pressure turbine. This device absorbs the steam in excess of that required by the turbine and then gives it up again automatically when there is a deficiency from the reciprocating engines.

Mixed pressure machines are now built to accomplish the same result. These are connected to both the exhaust supply and to the live steam main. In case of the exhaust failing a special governor admits live steam direct to the machine as long as required. This steam acts on the same bucket wheel as does the exhaust, being, in the Curtis machine for instance, expanded down to the same pressure as that of exhaust steam, and so obtaining a high velocity and being capable of giving up much more energy than if it were supplied at first stage pressure through a reducing valve or some such device. These mixed pressure machines can be operated to their full capacity on either all low-pressure steam; all high pressure steam, or on any proportions of each, and any transition from one to the other condition is automatic.

In conclusion, it is interesting to note the position taken by the Engineering News regarding the future of the turbines. This journal frankly states that these machines have reached a point where they seriously threaten the supremacy of hydroelectric plants. The main points advanced are:

1. The immense first cost of a reliable water-power plant with good storage reservoirs, etc.

2. The low cost of steam turbines due to moderate first cost and the immense size of the units built, and especially the low cost of the generators used with turbines, in proportion to their output.

3. The low cost of attendance and maintenance of steam turbines, and the economy obtained with great overload capacity.

A Russian electrical exhibit will be given by the Russian Technical Society of St. Petersburg in April, 1911. The exhibition will be divided into three sections, viz: (1) The application of electricity to the working of steam railways; (2) the application of electrical energy to train traction on (a) main railway lines, (b) local railways, (c) tramways; (3) the application of natural water-power. A commission of experts will make reports to the Russian government in regard to such exhibits as are most prominent from the view of public utility, and also those that most fully correspond with the aims of the exhibition. The Minister of Commerce must confirm all awards. It is regarded as important that anything new in connection with electrical traction, especially electromotors, monorail lines, and the like, should be placed on exhibition.

SUBURBAN GAS DISTRIBUTION.

BY L. H. NEWBERT.

Suburban gas distribution is a subject of growing importance and interest to the gas fraternity; and, as the title indicates, this paper will deal primarily with the question of supplying gas to territory adjacent to the larger cities. As a rule, these large centers of population are surrounded by small towns, villages, and sparsely settled territory extending over a large area, the residents of which are eager to enjoy all the conveniences of the city and, hence, make good gas consumers. On the other hand, the cost of piping will be high on a basis of the number of consumers supplied and will always require a large capital investment. For obvious reasons the low pressure system with its large pipes is impracticable and prohibitive. To meet the conditions cited, a high pressure system must be employed; and, that it does fulfill all requirements has been the experience of the writer during a period of more than five years.

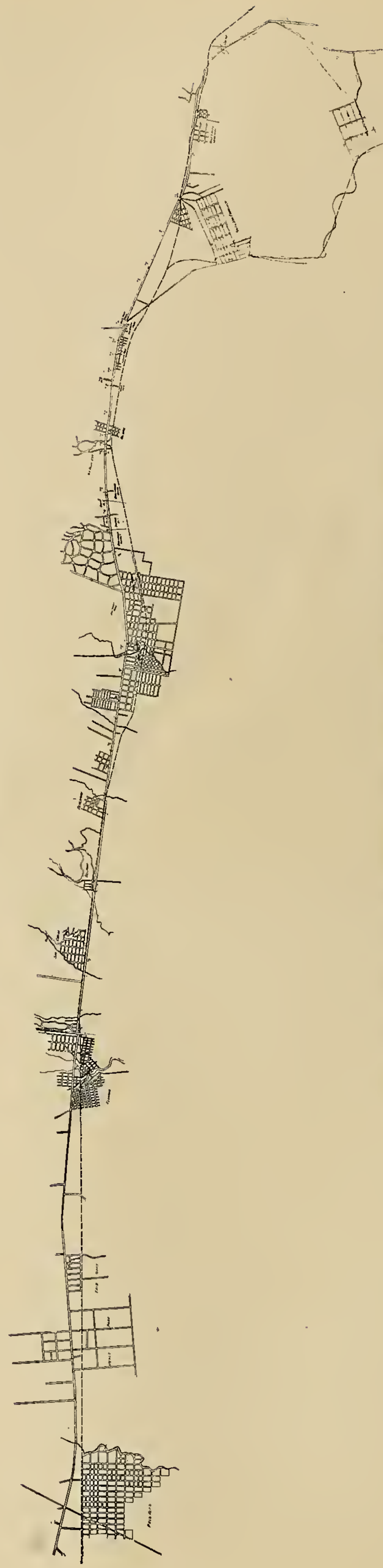
It must be of interest to note here that the distribution of illuminating gas under more than ordinary pressure was first undertaken, at least on the Pacific Coast, by the secretary of this association, Mr. John A. Britton, in the city of Oakland over twenty years ago when gas was conveyed from the Oakland works to a holder 2½ miles distant under a pressure of 15 lb. to the square inch. Subsequently, service was supplied to Berkeley under a pressure of 25 lb. through cast iron mains with lead joints. The mains were originally laid for low pressure service but proved satisfactory under the increased pressure. Today, as the result of the installation referred to, Oakland has an extensive system of high pressure distribution.

In 1901 the Los Angeles Lighting Company introduced high pressure distribution into the city of Los Angeles. A paper read by Mr. Luckenbach of the Los Angeles Gas and Electric Company before the sixteenth meeting of the Association describes in detail the beginning and subsequent enlargement of the system.

In 1902 the California Central Gas & Electric Company (a subsidiary company of the Pacific Gas & Electric Company) installed a high pressure distributing system to supply the towns of Grass Valley and Nevada City.

These installations, I believe, represent the commencement of high pressure gas distribution now so popular in this State, both for feeding into low pressure systems through district governors and for the supply of gas direct to consumers through service regulators in suburban territory as, for example, the district south of San Francisco lying between the coast foot-hills and the bay shore, commonly known as the San Francisco peninsula. Leaving San Francisco via Mission Road one finds this territory fairly well populated, there being four towns ranging from 3000 to 7000 population in a distance of 30 miles and the intervening districts well settled with individual residences —a territory in all respects suburban. As the entire peninsula district enjoys gas service, made possible only by resorting to high pressure distribution, a description of the system will illustrate, in general, the subject of this paper.

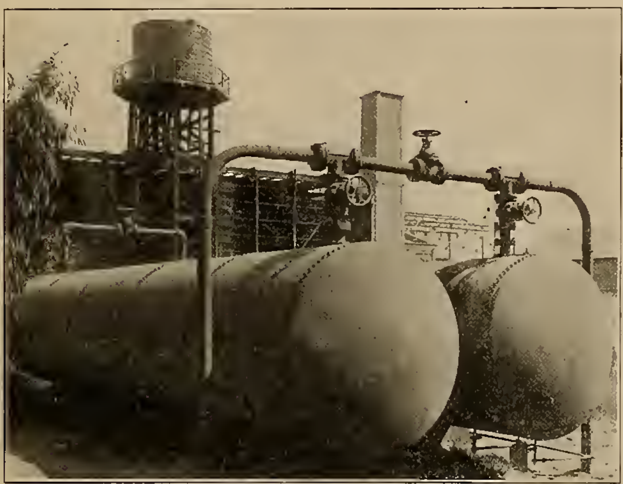
[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, Los Angeles, September, 1910.



30 mile High Pressure Gas Distribution between South San Francisco and Palo Alto, California

In the northeast corner of San Mateo county, just beyond the line of the city and county of San Francisco, and on the shore of San Francisco bay, lies Visitacion Valley. Here is situated Martin Station, named for a former president of this association. It is from this point that gas is supplied to the aforesaid 30 miles of suburban territory lying between San Francisco and Palo Alto.

A four-inch pipe line extends from the receiving tanks at Martin Station to Redwood City, a distance of 25 miles. Three-inch pipe is then used for 4 miles, from Redwood City to Palo Alto. The line follows the main county road the entire distance and, when laid, was tested with air, the pressure employed being 100 lb. to the square inch. All joints are made with Dresser couplings which, to date, have been found quite satisfactory though a careful watch is kept for leaks, and a few have been found but were easily corrected by tightening the couplings. Compressors at Martin maintain an initial pressure on the main line

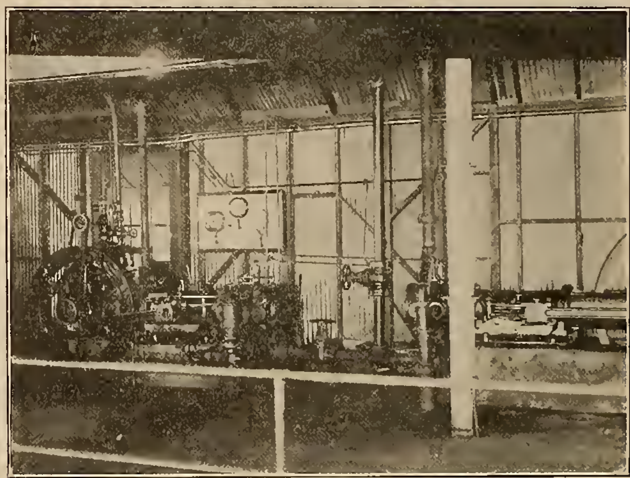


Compression Tanks at Martin Station. Gas from compressors passes into right hand tank, through connection at further end, into left hand tank, and out through pipe at left to main.

of from twenty to fifty-five pounds. For the twenty-four hours the pressures are approximately as follows:

		Martin.	Redwood.
1 a. m.	Compressors down	25 lb.	25 lb.
2 "	" "	25 "	23 "
3 "	1 compressor running	24 "	20 "
4 "	Compressors down	25 "	24 "
5 "	1 compressor running	23 "	21 "
6 "	2 compressors running	35 "	26 "
7 "	" "	45 "	28 "
8 "	" "	45 "	25 "
9 "	" "	44 "	25 "
10 "	" "	44 "	25 "
11 "	" "	45 "	27 "
12 m.	" "	48 "	28 "
1 p. m.	Compressor down	45 "	25 "
1 p. m.	Compressors down	45 "	25 "
2 "	1 compressor running	27 "	20 "
3 "	1 " "	30 "	20 "
4 "	1 " "	30 "	20 "
5 "	2 " "	50 "	27 "
6 "	2 " "	50 "	27 "
7 "	1 " "	50 "	24 "
8 "	1 " "	45 "	25 "
9 "	1 " "	40 "	28 "
10 "	1 " "	40 "	32 "
11 "	1 " "	40 "	33 "
12 "	Compressors down	30 "	29 "

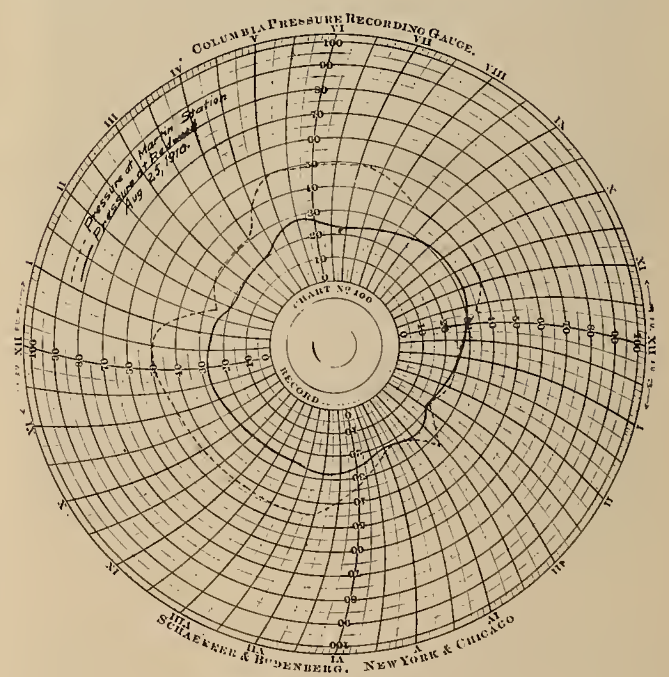
Consumers between Martin and Burlingame are supplied directly from the main line. At San Mateo a tap is made in the main line which supplies service to San Mateo, Burlingame and vicinity. This service is supplied through a four-inch governor which reduces the pressure to 10 lb. Two-inch pipe is usually employed for mains in these districts, though some smaller has been placed and has given satisfactory service, care having been taken to secure proper circulation by eliminating dead ends. No pipe smaller



Compressors at Martin.

than two-inch, however, is now used for mains, the idea being to carry lower pressure rather than small mains and higher pressure, for obvious reasons—leakage.

Four compression or storage tanks 6 by 30 ft., containing approximately 17,000 cu. ft. of gas, are installed at San Mateo, on which a pressure of 80 lb.



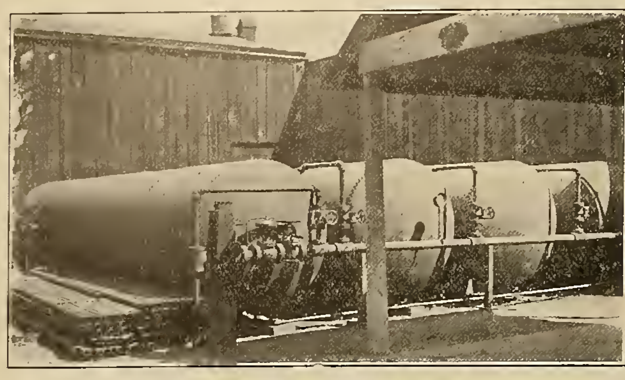
Pressure Gauge Record.

is maintained; and these are held in reserve in case a shutdown is necessary for repairs on the main line.

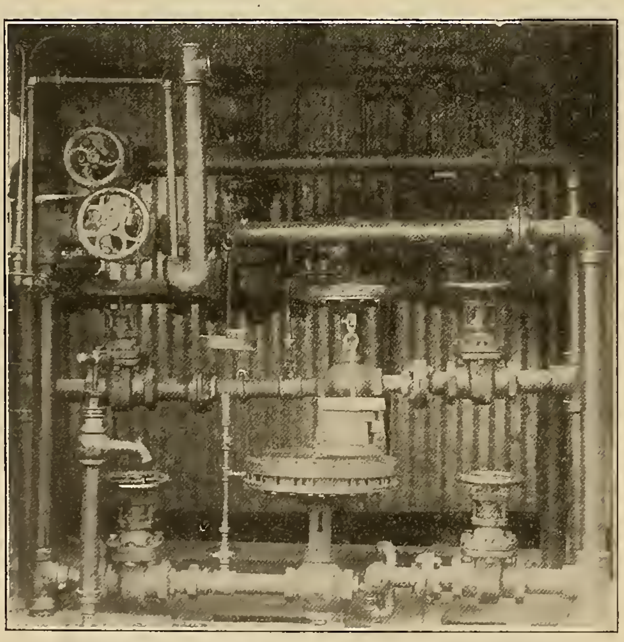
Consumers in the district intervening between San Mateo and Redwood City, a distance of eight miles, are supplied directly from the main line. Redwood City (excepting the business district, which is low pressure) and its immediate vicinity are supplied similarly to the San Mateo-Burlingame district; i. e.,

through a four-inch governor at 10 lb. Here six compressors or storage tanks, containing 25,500 cubic feet of gas, are installed and operated in the same manner as those at San Mateo.

The four miles of territory intervening between Redwood City and Palo Alto is the most thickly settled, truly suburban district on the peninsula, especially near the stations, Fair Oaks and Menlo Park. At the former place a distributing system consisting of two-inch main exists, service being supplied to the system from the main line through a two-inch district governor, and a pressure of ten pounds is maintained here also.



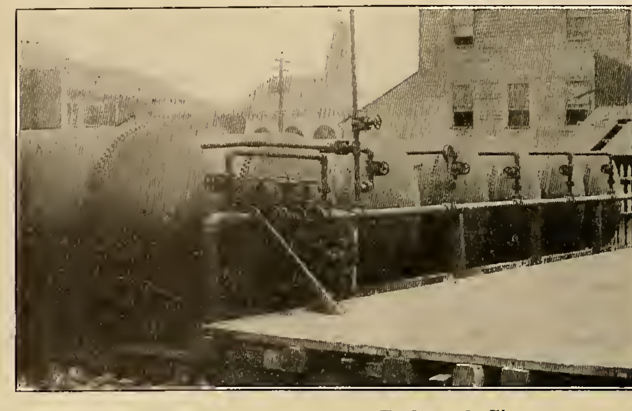
Compression Tanks at San Mateo.



Governors on Lines Feeding Out From Redwood City.

At Menlo Park there is the only low pressure distributing system in the peninsula territory. A number of years ago a wealthy resident erected a gas plant and laid several thousand feet of four-inch mains to supply his neighbors The plant ceased operations after the earthquake of 1906 and the distributing system was taken over by the Pacific Gas and Electric Company. The mains were tested to 5 lb. gas pressure and found comparatively tight; but, as the four-inch mains provided ample capacity, it was decided to operate at low pressure. Accordingly, a district governor was installed in a waterproof manhole, which governor reduces the pressure from pounds on the main line to four and one-half inches on the distributing system.

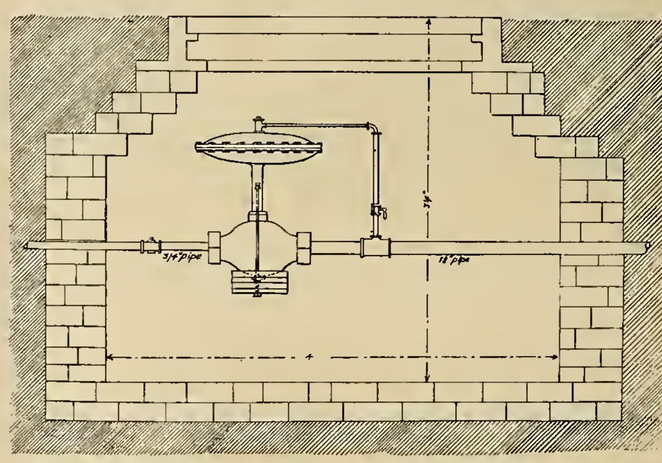
Service is supplied to Palo Alto through four compression or storage tanks located underground. Two district governors reduce the pressure to, approximately, ten pounds on the distributing system.



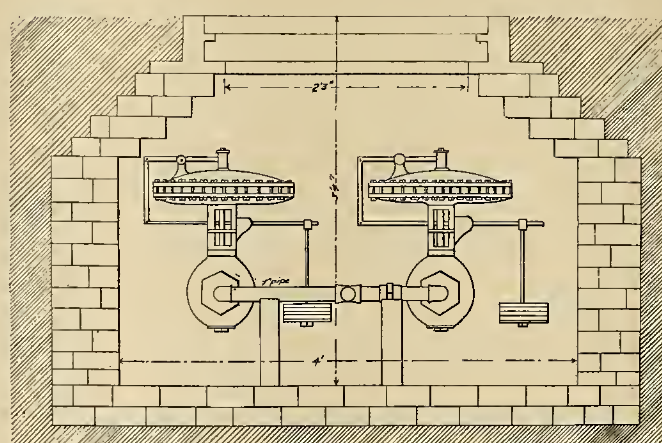
Compression Tanks at Redwood City.

Individual service regulators are installed on all services on the consumers' premises in a position easy of access and where, should the seal blow, the gas will escape outside the building.

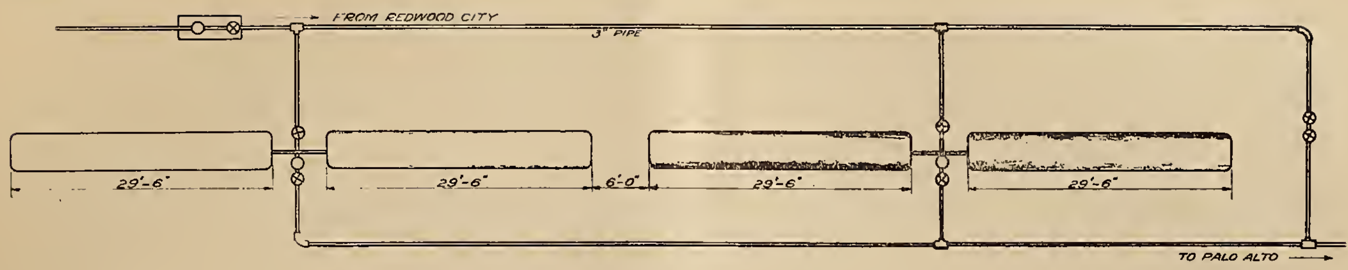
The regulators are adjustable and pressure may be varied from three to six inches. For service connection three-fourth-inch pipe is generally employed,



Manhole at Atherton Avenue and County Road, Fair Oaks.



Manhole at Oak Grove Avenue and County Road, Menlo Park.

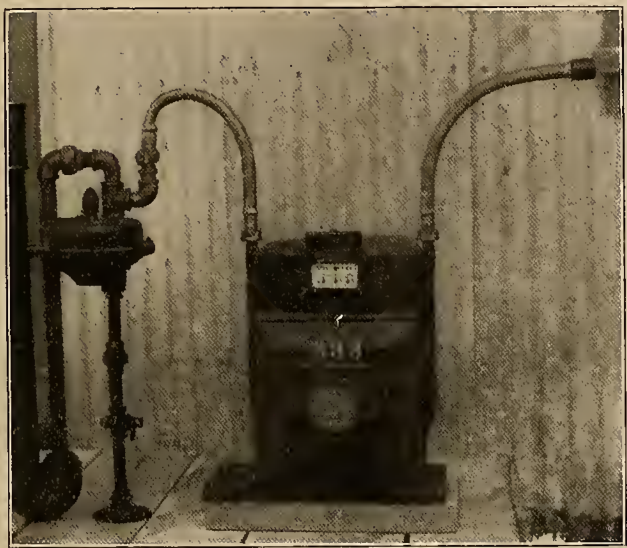


Gas Tanks and Connections at Palo Alto.

⊕ CHECK VALVE
○ WHEEL VALVE GOVERNOR

though one-half has been found satisfactory for the smaller houses. Services are connected to the main by tapping and using service clamps with lead gaskets which make a perfectly tight joint.

The reader or auditor who follows the description of this system, because of its seeming complication, would naturally conclude that much attention will be constantly required throughout the distributing territory. This is not the case. Comparative investigation and experience have demonstrated that this system is operated with less trouble and fewer complaints than low pressure, and the service to the consumer is all that can be desired.



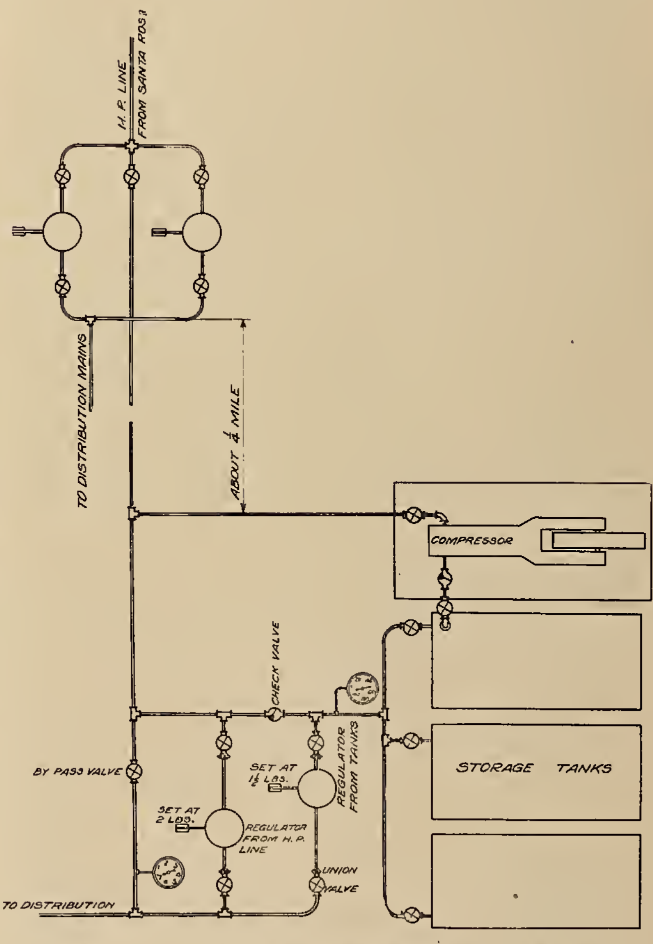
Service Regulator and Oil Seal as Installed with Meter.

The system briefly outlined in the foregoing pages serves a territory having at present a population of approximately 30,000 people, distributed over an area of about sixty-six square miles; hence, it may well be termed a system for supplying gas to suburban territory.

It is almost needless to state that the installation of a high-pressure system requires the utmost care, as a leak the size of a pinhole is like a plug out in a low-pressure system. All work should be performed with the greatest care and should be done under the supervision of a most painstaking foreman. All mains laid should be tested with air pressure considerably in excess of the gas pressure to be employed. For this work a portable air compressor should be used and pressure should be kept on for several hours.

When tubing is used and the joints are made with Dresser couplings, particular care should be taken to see that the flanges are drawn up evenly so that the pressure on the gasket is even, otherwise the flange is apt to bind on the pipe and a leak will develop.

Pipe used for high-pressure service should be most carefully coated with, at least, two coats of the best metal preservative. At this writing the writer is inclined to favor Biturine, especially in ground affected by tide water. When screw pipe is used a die should be run over the threads to insure proper cut. Line pipe sockets only should be used and the joint should be made with litharge and glycerine. All iron fittings should be extra heavy. Brass fittings, valves, etc., should be extra heavy and of the best workmanship.



Method of Installing Storage Tanks and Governors to Supply Peak Demand.

While pipe as small as one inch has been employed in high-pressure systems, I favor using nothing smaller than two inch, even in sparsely settled territory, as the increased capacity will permit carrying lower pressures, which means less leakage.

While good results have been obtained by direct service from mains carrying as high as 75 lb., I do not think the practice should be encouraged. It is far better to keep the higher pressure lines free from service connections, using them only to convey the gas to a central point, or points, where the pressure should be reduced, for the distributing system, as low as the demand on the system will allow. This can be ascertained by taking pressures occasionally some distance from the distributing center with a recording gauge. A battery of storage tanks should be installed at the distributing center of sufficient capacity to meet peak requirements. These should be filled from the main line by means of a compressor at off peak times and turned into the distributing system by means of an automatic governor when the pressure on the distributing system falls to a certain pressure. An installation of this kind exists at the Petaluma plant of the Pacific Gas and Electric Company and the results are most satisfactory. The arrangement is clearly shown in the drawing herewith.

Another point which must not be overlooked on a high-pressure system is the care of service regulators. Regular inspections should be made to see that they are in proper working order. If this is done the service should be as near perfect as possible.

As yet, metering large quantities of gas under high pressure has not been successfully done, but both the Rotary Meter Company and the St. John Meter Company will shortly place on the market meters which promise to be satisfactory. The Pacific Gas and Electric Company intend trying these meters out and some interesting data should be obtainable at the next meeting of this Association.

Varying conditions will necessarily produce varying requirements for each suburban territory, but, in a general way, the foregoing will apply to any suburban district.

DISCUSSION ON STEAM ENGINEERING PRACTICE.[1]

A Few Hints on Scotch Boilers.

A Scotch boiler as usually termed, is a steel, cylindrical, longitudinal, wet bottomed, marine boiler.

The advantages of corrugated furnaces over plain furnaces are: (a) better for expansion, (b) more metal, (c) diameter and not the diameter squared as with the plain furnace, (d) corrugations strengthen the furnace, (e) more heating surface for the same length.

The main stays are usually from 2 in. to 3 in. in diameter and pitched at from 14 in. to 16 in., and are arranged in horizontal and perpendicular lines. The stress allowed is 7000 lb. if iron and 9000 lb. for steel per square inch.

Boiler overheating is caused by shortness of water; allowing the water to become too dense; accumulation of scale on the heating surfaces; deposits of oil on the heating surfaces; or plates too thick, as furnaces 1¼ in. thick would burn down until they were ⅝ in. thick.

Boiler priming is caused by dirty water, or hard firing. The remedy is to open the cylinder drain cocks and slow down the engine until water is steady again in the gauge glass.

If when blowing down the boiler the blow down cock becomes jammed, slack the gland and ease the cock, as this may be due to unequal expansion between the cock and shell.

Getting up steam in a Scotch boiler should never be attempted in less than 12 hours, that is from the moment of lighting the fires until you have working pressure. If possible take 24 hours, for the slower the boiler is heated the more equal the expansion, as in this case the bottom of the boiler gets every chance to heat as well as the top. Keep the donkey pump circulating the water in the boiler for a few hours, or better if you have a hydrokineter use it.

If a boiler rivet is leaking badly, draw fires and blow down boiler, then knock out rivet and put in a bolt which would do temporarily until a chance could be had to put in a new rivet.

If a broken check valve stem cannot be adjusted, regulate the feed water by means of the main throttle valves. If there is more than one boiler, shut down the throttle valve on whichever boiler has most water in it. If only one boiler use auxiliary or donkey check valve to regulate feed water.

If the bottom seams leak, dress and caulk, and use due precaution in the heating up of the boiler.

The manhole door and manhole are made oval, to allow the door to be taken out and put in at will as the door is larger than the manhole. If square or round the door would always have to stay inside the boiler and would be in the way for inspection and cleaning.

Fire-bars should have a droop of one inch to every foot length. If grate length is five feet, the droop is five inches. If the furnace is three feet in diameter two feet should be the height of fire brick, leaving one foot for the heat and flame to pass into the fire box. If arch bricks are used the height of beaters and fire bricks should then be three inches less, as the arch bricks are generally about 3 in. thick. The arch bricks are used to save the rivets of the furnaces as the greatest heat goes on the brick. When cleaning fires the arch bricks are often knocked down and this is one of the reasons that the engineers have not used them permanently. If short of fire clay and the bricks are loose a very good plan is to break up a few fire bars to the proper length and place them between the bricks. The excessive heat melts them between the bricks and they adhere to the bricks and make a very good substitute for clay.

How to fire a Scotch boiler:

(1) Place some wood on top of fire bars and then apply a piece of waste with some oil on it between two layers of the wood and then cover same with a thin coating of coal, then apply a light.

(2) Keep a slow fire burning to warm up the boiler slowly, say for 4 to 6 hours. Let the steam rise easily as forcing the boiler means leaky rivets and seams owing to the unequal expansion of the top and bottom of the boiler.

(3) Use the circulating pump, usually a Weir's or vertical donkey pump.

(4) At sea a good fireman waits until the coal is red all over before putting on the next fire. It is a good plan when throwing the coal in to let the fireman's shovel lightly touch the front of fire entrance as the coal then spreads over the fire. Push the coal which has been half burned from the front of the furnace to the back and throw the green coal on at the front. This means that you are getting the most heat and at the same time the heat from the glowing coals will be consuming the gases in the smoke which is passing from the green coal at the front.

(5) Use the fire-hoe to keep the fire level and see that the fire-bars are covered or otherwise there will be a loss in the draught and a poorer fire and less steam.

(6) Pass the slice bar occasionally under the coal, easing the clinker and letting the air pass through freely.

CHARLES MORTON.

[1]California No. 3, N. A. S. E.

CURRENT COMMENT

The Denver Electrical Show opens on October 8, continuing one week thereafter.

A rotary air compressor capable of compressing twenty thousand cubic feet of free air per minute to a pressure of 118 pounds is being manufactured in Germany. The compressor runs at 4000 r.p.m. and has twelve stages.

A new Peruvian electric railway is to be built for 80 miles between Ancon and Huacho. It is to be operated by power to be developed from the river Chancay, or Pasamayo. Any excess of power is to be sold to the sugar plantations.

Increased membership in I. E. S., the Illuminating Engineering Society, is reported as a result of the campaign started by J. Robert Crouse in June of this year. The addition of 500 names represents an increase of 50 per cent in the total membership.

Examination for clerk-draftsman is announced by the United States Civil Service Commission on October 19-20, 1910, to fill vacancies as they may occur in the position of clerk-draftsman in offices of surveyors general, Land Office Service, at salaries of about $4 per diem or $1200 per annum.

An electrically cooked dinner for 18 persons, the dinner including soup, roast beef, Lima beans, potatoes, shortcake and coffee, was recently served at Chicago. The entire operation took two hours and required 2310 watthours which at 10 cents cost 23.1 cents, an average of 1.28 cents per person.

The statue of Lord Kelvin, by Mr. Albert Bruce-Joy, which is to be erected in Belfast, Ireland, Lord Kelvin's birthplace, is nearly ready. The figure stands 10 feet high. On the right hand is a design of Kelvin's gyroscope, and on the left a model of the Kelvin compass. The statue will be cast in bronze.

The hot wire system for tungsten lamps is being used on Eastern railroads to minimize breakage. A small current, keeping the filament at a dull red, is always on the line, thus giving longer life to the filament. The lamps are lighted from storage batteries at 60 volts, this being reduced to 4 volts when the lamps are extinguished.

A combination engine and boiler has been developed in Germany to give one horsepower hour per pound of coal burned. The cylinder and steam dome are cast in one piece and riveted to the boiler shell. This eliminates radiation and condensation in long steam pipes and utilizes the waste heat from the furnace gases in superheating the steam.

Newly elected national officers of the N. A. S. E. at the Rochester convention in September are Carl S. Pearse, Denver, Colo., president; Edward H. Kearney, Boston, Mass., vice-president; Fred W. Raven, Chicago, Ill., secretary; Samuel B. Forse, Pittsburg, Pa., treasurer; Joseph J. Gibney, Mobile, Ala., conductor; W. H. Lockett, Dallas, Tex., doorkeeper.

Examination for assistant forest rangers is announced by the Civil Service Commission on October 24-25, 1910. The U. S. Department of Agriculture estimates that 400 eligibles will be needed during the field season of 1911. Assistant forest rangers are paid an entrance salary of $1100 per annum. The examination will be held at National forest headquarters throughout the Western States.

Amateur wireless operators are organizing under the direction of George Hiram Mann, an attorney of Washington; first, to defeat the Depew bill; second, to secure the passage of the Roberts joint resolution, which provides a commission to take testimony before any legislative action is adopted, and, third, to secure an expression on behalf of all the amateurs, favoring some positive legislation which will give them protection.

A potato as a polarity indicator is described by a writer in Power. Upon inserting the two current carrying wires into a freshly cut surface a green stain due to dissolved copper indicates the positive wire. If both wires are surrounded by dark colored stains the current is alternating. Another method is to hold a bar magnet near a lighted incandescent lamp. If the current is alternating the filament will vibrate, if direct it will be attracted or repelled according to the sign of the magnet pole presented.

Average daylight, as defined by Ives closely corresponds to the light emitted from a black body at 5000 degrees absolute. As shown by the Ives colorimeter its sensation values for red, green and blue are 33 1-3 per cent for each. Of all the artificial illuminants the Moore carbon dioxide tube has been found to be nearest to this standard, being 31.3 red, 31.0 green and 37.7 blue. As time has advanced the tendency has always been toward a whiter light from the open fire place, to the candle, to the ordinary oil lamp, to the gas lamp, to the carbon incandescent, to the Welsbach, to the Nernst, to the tungsten, to the acetylene, to the arc lamp, to the Moore tube.

Coal briquettes were produced in the United States last year in greater quantity than ever before, according to the U. S. Geological Survey, but the output is still insignificant compared with the 18,000,000 tons made annually in Germany. The American product in 1909 is reported as 139,661 short tons, valued at about $453,000. This is an increase of 54 per cent over the production of 1908. The reason for the much greater production in Germany is stated to be the cheapness of labor there, the greater cost of coal, and the practice of coking coal in retort ovens which yield a large quantity of pitch suitable for use as a binding material for briquettes. The Geological Survey states that here the briquette industry is held back by the large supply of cheap natural fuel, by the high cost of labor, and by attempts to exploit secret processes for which extravagant claims are made but which have failed to make good.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Entropy

When a child first learns to add he cannot deal with abstract numbers but requires some familiar object, such as apples or blocks, as a sort of mental crutch to assist his understanding. We all employ such artifices in trying to comprehend complex subjects. The Saviour spoke in parables. The attraction of gravity or of magnetism may be explained by the assumption that they act along lines of force. The hydraulic analogy simplifies the mystery of electricity. Meridians of latitude and of longitude help the surveyor and geographer. But parables are not literally true; there are no actual lines of magnetic force; neither is electricity water; nor the equator "a menagerie lion running around the center of the earth."

Among the most difficult subjects to comprehend is the science of thermodynamics which gives a mathematical explanation of the work done by steam in an engine. By drawing a diagram of what takes place these difficulties are somewhat simplified. Every steam engineer is familiar with such a diagram in an indicator card which represents the steam's work as an area equal to a summation of the product of the volume and the pressure at all points in the piston movement. Most engineers know how to compute the indicated horsepower from the mean effective pressure thus determined, and how to calculate the indicated steam consumption with the assistance of steam tables. But when it comes to finding the character of the expansion and determining the loss due to cylinder condensation and to wire drawing the indicator diagram is not satisfactory.

This inadequacy may be obviated by the use of an entropy diagram. Entropy is one of the most illusive, intangible and least understood of all engineering terms. Heat is assumed to be a compound quantity consisting of two factors, one the absolute temperature, the other entropy. Just as work is graphically represented in the indicator diagram as the product of pressure and volume, so is heat imparted diagrammed as the product of temperature and entropy. In the steam tables entropy is given as a decimal fraction which has been computed by the methods of higher mathematics.

The value of this factor for water increases from 0 to 0.67 as the absolute pressure increases from 0.0886 to 600 pounds per square inch, while the entropy of evaporation correspondingly decreases from 2.1832 to 0.783.

The physical conception of this "ghostly quantity" which cannot be perceived by the senses or measured by any gauge or meter is as difficult as is that of the fourth dimension. For all practical purposes it is sufficient to accept it merely as a length in a diagram or as an abstract numerical quantity in the tables, largely as a matter of faith, being much like religion in this respect. Before the commercial development of the steam turbine most engineers side-stepped this question, but now it is necessary for them to go back and brush up on the subject. Rightly applied it is a powerful tool in attacking steam problems. It is not necessary to bother about what entropy is, but it is certainly advisable to find out what can be done with this device.

PERSONALS.

A. M. Hunt, electrical engineer, left on a trip to San Diego last Tuesday.

K. Kasper, who has electric lighting interests at Vallejo, spent last Tuesday at San Francisco.

K. G. Dunn, engineer with Hunt, Mirk & Co., has returned to San Francisco, from a northern trip.

R. S. Buck, of the engineering staff of Sanderson & Porter, is expected in California about October 15.

J. F. Meister has been appointed instructor in electrical engineering at the Oregon Agricultural College, Corvallis, Oregon.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast office, returned to San Francisco last week from Los Angeles.

John Coffee Hays, general manager of the Mt. Whitney Power Company, of Visalia, was a San Francisco visitor during the past week.

A. W. Vinson, representing Cutler, Hammer Mfg. Co., as engineer, with Otis & Squires, has been transferred to the home office at Milwaukee.

H. A. Tedford, general superintendent of the Northern California Power Company, spent last Tuesday at the company's San Francisco office.

George Hawkins, with Chas. C. Moore & Co., engineers, recently returned to San Francisco with several good contracts from the Hawaiian Islands.

Thomas Mirk, of Hunt, Mirk & Co., Pacific Coast representatives of the Westinghouse Machine Co., left last Monday for Los Angeles and San Diego.

Leon M. Hall, of Hall, Demarest & Co., spent the past week in Merced County, on engineering work connected with the construction of irrigation dams.

George I. Kinney, Pacific Coast manager for the Fort Wayne Electric Works, has returned to his San Francisco office after paying a visit to Los Angeles.

E. H. Rose of Los Angeles has been appointed manager at Maricopa, Cal., for the Midway Light & Power Co., which recently took over the interests of the West Side Electric Company.

Cary T. Hutchinson, a consulting electrical engineer at New York City, is examining the plant of the Klickitat Valley Development Co. under construction near Glenwood, Washington.

H. T. Edgar has been appointed manager of the Seattle Electric Co. Since 1898 Mr. Edgar has been manager of Stone & Webster properties at Lowell, Mass., and at El Paso, Texas.

F. B. Gleason, manager of the Western Electric Company's San Francisco branch, recently returned from a trip to Salt Lake City, and reports that business has improved all along the line.

A. L. Searles, manager of the electric rock drill department of the Fort Wayne Electric Works, left Los Angeles last Saturday for Madison, Wis., after spending several weeks on the Pacific Coast.

W. N. Winter has been elected manager of the Home Telephone Company at Hood River, Ore. Charles Hall, president of the company, who has been manager of the system, will be the managing director.

George Spaulding, representing E. M. Burgess, the general manager of the Colorado Telephone Company, has arrived at San Francisco from Denver and is inspecting the Pacific Telephone & Telegraph Company's system.

H. M. Byllesby, head of H. M. Byllesby & Co., of Chicago, is at San Francisco on business connected with investments in electric power plants in California and elsewhere. He was accompanied by A. F. Stevens, of his engineering staff.

H. C. Deering, manager of the Humboldt Gas & Electric Company of Eureka, Cal., has been at San Francisco.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company, has returned to his San Francisco office after a Southern California tour.

R. E. Starkweather, who has has charge of the construction of the Great Western Power Company's transmission lines for the past two years, has resigned his position to engage in private construction work, particularly of pole lines.

A special board of army engineers, appointed by President Taft to inspect and report upon the Government reclamation projects now under way, were at San Francisco during the past week, accompanied by F. H. Newell, director of the reclamation service. The personnel of the party included Brigadier-General W. L. Marshall, advising engineer; Colonel William C. Longfit, Lieutenant-Colonel John Biddle, and Majors William W. Harts, Charles W. Kutz and Harry Burgess. The work already inspected includes that on the Truckee-Carson project at Fallon, Nev., and the Government irrigation project at Klamath Falls, Ore. The Imperial Valley project, in California, will next be investigated.

TRADE NOTES.

Geo. F. Willoughby has bought the business of the Hunter Electric Co. at Eugene, Oregon, and will conduct it in his name.

The Burton R. Stare Co., dealers in electrical supplies at Seattle, have moved to enlarged quarters at 115 Prefontaine Place.

James C. Maitland has bought out the interest of P. H. Ridgway in the Electrical Engineering Co., electrical contractors, 112 Marion street, Seattle.

The office of the Western Carbon Battery Co., has been removed from the American Bank building, Seattle, to the factory, 1906 Seventh avenue, near Westlake, Seattle.

The Westinghouse Electric & Manufacturing Company has recently received an order from the Simonds Manufacturing Company for six 500 k.v.a. O. I. S. C. transformers, two 200 h.p. type HF rolling mill motors to be used in the new Lockport, New York, plant of the purchaser. The transformers will be used in stepping down the power purchased at 12,000 volts to 480 volts. One of the motors will be used on the band sawmill and the other on a cross cut sawmill. The motors will be geared to the mills, which will consist of two stands each. The motors will be of the Westinghouse extra heavy rolling mill type, so constructed as to permit the moving of the stator sideways in case of necessary repairs to the rotor.

J. G. White & Company, Inc., have been awarded a contract for the engineering and construction of a steam and electric power plant to be built for the Power Transit & Light Company, at Bakersfield, Kern County, California. The building will be 82 feet by 140 feet, with substructure of concrete, self supporting steel frame, and walls of metal lath and plaster, which is the usual form of construction throughout lower California, and will be designed to accommodate two 2000 kilowatt horizontal turbines, with boilers, condensers and necessary auxiliaries. A 750 kw. turbine will be temporarily installed at the earliest possible date. Water for condensing purposes will be obtained from an irrigation ditch near the plant, and the water for boiler purposes will be supplied from wells to be driven near the power house. As the boilers will be installed with oil burners, there will be no basement under the boiler room. The station will be designed electrically to deliver practically full load at either 60,000, 10,000 or 2300 volts, and will operate at all the above pressures simultaneously. The estimated cost is approximately $400,000.

INDUSTRIAL

WHAT ONE CENT'S WORTH OF ELECTRICITY WILL DO.

The Southern California Edison Company of Los Angeles has prepared the following data on the current consumption of various household appliances whose chief delights are their convenience, cleanliness and the fact that many dishes may be electrically prepared upon the dining table:

Coffee Percolator.

One cent's worth of electricity will make six cups of delicious coffee in an electric percolator, which is operated upon the dining table, requiring no service from the kitchen. The percolator is as beautiful as the coffee urn and an ornament to the table.

Electric Water Boilers.

One cent's worth of electricity will bring to a boil four quarts of water, or operate the baby milk warmer two times. These water heaters are adaptable for boiling eggs on the dining table, or any purpose for which hot water is required.

Electric Sewing Machine.

One cent's worth of electricity will operate an electric sewing machine motor for five hours. This little device attached to an ordinary sewing machine takes away all of the hard work incident to the family sewing.

Electric Heating Pads.

One cent's worth of electricity will keep an electric heating pad hot for three hours. These pads are provided with the thermostat, which automatically prevents the temperature from becoming too high. Indispensable for the sick room and the sleeping porch.

Electric Shaving Mugs.

One cent's worth of electricity will heat water in an electric shaving mug for twelve shaves. The water is heated almost instantly, and if the current is turned on upon arising, plenty of hot water will be available for the morning shave.

Electric Chafing Dish.

One cent's worth of electricity will operate the beautiful electric chafing dish, which has come to be a feature in society luncheons, long enough to make a Welsh rare-bit.

Electric Broilers.

One cent's worth of electricity will run an electric broiler for ten minutes. The broiler is also intended for use on the dining table. The broiler will prepare chops and steaks for the meal while the coffee is making in the percolator.

Electric Disc Stoves.

One cent's worth of electricity will keep an eight-inch disc stove hot for fifteen minutes. The electric disc stove is an appliance which can be used for many purposes. It is handsome in design.

Electric Griddles.

One cent's worth of electricity will operate an electric griddle for fifteen minutes. These appliances are highly appreciated by families who are fond of hot cakes. With the electric griddle they can be cooked upon the table. No trotting from kitchen to dining room with every plate of cakes.

Electric Foot Warmers.

One cent's worth of electricity will keep an electric foot warmer hot for thirty minutes. The current is turned on and the surface is just large enough to place the feet upon and radiate the proper amount of heat to warm the feet without overheating the room or vitiating the air.

Electric Flatiron.

One cent's worth of electricity will keep a six-pound electric flatiron hot for fifteen minutes. This is long enough to do the dainty family ironing, such as fabrics that are too fine to entrust to your Chinaman.

Luminous Radiators.

One cent's worth of electricity will operate the luminous electric radiator for twelve minutes, wihch is long enough to heat the bed room while dressing, take the chill off the dining room in the early mornings and heat the bath room. Its use for heating small rooms is within reach of all our consumers.

The Electric Toaster.

One cent's worth of electricity will heat an electric toaster for fifteen minutes, which will make about twenty slices of toast. The toaster is made especially for the dining table, but it is often used at the bedside and in the sick room. This is an ideal small appliance.

Electric Toaster Stove.

One cent's worth of electricity will operate the electric toaster for fifteen minutes. It is a generally utility appliance for light work and will make hot cakes, toast, coffee, broil chops, heat water and fry eggs, and a number of other things, and is absolutely indispensable.

Electric Tea Kettles.

One cent's worth of electricity will operate an electric tea kettle for fifteen minutes . These kettles are furnished in two capacities—for two and four quarts. The two-quart has two heats—high and low heat; and the four-quart kettle three heats.

PERE MARQUETTE USING TELEPHONES FOR TRAIN DISPATCHING.

The Pere Marquette is soon to join the already long list of railroads using the telephone to dispatch trains, supplanting the telegraph, which was considered the standard for handling train movements for a great many years.

The Pere Marquette has ordered instruments, selectors and line material to equip a line from Saginaw, Michigan, to Toledo, Ohio, approximately 135 miles in length, with the telephone for train dispatching. This is understood to be the beginning of the adoption of the telephone system over the entire road, extensions to follow the completion of the first circuits.

Between Saginaw and Toledo there will be thirty telephone stations. The chief dispatcher will be at Saginaw. The entire equipment is being furnished by the Western Electric Company.

Because of the great ease and facility of transmission, the telephone has in the past couple of years been making rapid strides into favor among railroad managers. It performs the work formerly done by the telegraph in a more rapid and efficient manner, and the adoption of the telephone standard by a great many of the largest railroads in the country has caused a complete change in dispatching methods.

Braun, Williams & Russell, Inc., mechanical engineers and contractors, 503 Market street, San Francisco, announce that the name of the firm formerly known as the Standard Engineering Company, of 503 Market street, has been changed so as to incorporate the names of the members and in the future will be known as Braun, Williams & Russell, Inc.

NEWS NOTES

FINANCIAL.

MITCHELL, ORE.—The Council has passed an ordinance providing for the issuance of bonds in the amount of seven thousand dollars for the purpose of constructing waterworks to supply the town with water.

SAN BERNARDINO, CAL.—A certificate of bonded indebtedness in the sum of $150,000 has been filed with the County Clerk by the Yucaipa Water Company No. 1. The bonds run twenty years and bear 6 per cent interest. It is proposed to use the money obtained from a sale of bonds in completing the water scheme planned for Yucaipa Valley.

INCORPORATIONS.

EI CENTRO, CAL.—The Imperial Valley Electric Co. has been formed here for the manufacture of electric fixtures.

TENINO, WASH.—The Mud River Coal & Gas Company, capital $500,000, has been incorporated by N. H. Truett and Geo. F. Clement.

CARROLTON, WASH.—The Mount Pleasant Telephone Company, capital $300, has been incorporated by C. H. Wood and Mont Barber.

SEATTLE, WASH.—The Alaska Radio Telegraph Company, capital $250,000, has been incorporated by Lee De-Forest, Edwin H. Flick, Leary building and Walter Loewe.

LOS ANGELES, CAL.—The Valley Water Company has been incorporated by F. D. Lanterman, B. Hayman, G. H. Stoll, F. G. Haven and W. T. Somes, with a capital stock of $6500.

SAN FRANCISCO, CAL.—The Marin Improvement & Water Company has been incorporated by G. G. Vickerson, S. N. Darbee and J. R. Moulthrop , with a capital stock of $10,000.

HONOLULU, H. T.—The Honolulu Electric Co., Ltd., has been incorporated by H. E. Martinez, A. J. Greene, C. C. Bitling, C. L. Sebolt and A. K. Ozaiva, with a capital stock of $50,000.

ONTARIO, CAL.—The Mayamar Water Company has been incorporated by G. A. Hanson, C. E. Sears and I. C. Baxter, who have purchased the water bearing acreage at the mouth of the San Antonio canyon.

MARTINEZ, CAL.—The California Natural Gas Company has been incorporated by H. D. Pillsbury and Alfred Sutro of San Francisco, C. C. Sullivan of El Valano, F. D. Madison and E. T. Zook of San Rafael with a capital stock of $1,000,000.

WHITE SALMON, WASH.—An incorporation of White Salmon and local capitalists capitalized at $10,000 have launched a campaign to secure $2,000,000 for the construction of an electric railway line from White Salmon to the upper White Salmon valley. Survey has been completed as far as Robertsville.

ILLUMINATION.

ALBANY, ORE.—It is announced that a gas franchise will be granted to P. G. Rowe and that a plant to cost $100,000 will be erected.

QUESNEL, B. C.—Wallace McMullan is promoting a scheme for installing an electric light and power plant here to be run by steam.

BOZEMAN, MONT.—A gas franchise has been granted to Dr. Carl Schroeter and J. C. McCarthy. The plant to be erected will cost $100,000.

CORVALLIS, ORE.—P. G. Rowe has asked for a gas franchise to begin the construction of a plant within six months if franchise is granted.

LONG BEACH, CAL.—The stockholders of the Inner Harbor Gas Co. have voted in favor of selling the business and property to the new Consolidated Gas Company, which is taking over the properties of this and the Edison Company here. The new company will proceed at once with an issue of bonds.

RIVERSIDE, CAL.—The Southern California Edison Company has taken out a permit for the erection of a brick building at the site of its gas plant at Pachappa avenue and Tenth street. The structure will house the compressor and other machinery to be installed. Pipes have been laid which will enable the company to supply gas to Arlington.

BISBEE, ARIZ.—Enlargement of the gas plant and the extension of the lines of the Bisbee Light and Power Company will be started by the last of October or the first of November. The plant will build pipe lines to Upper Lowell and Warren besides being generally extended over town to give service to those parts of the city that are now at some distance from the mains.

SANTA CRUZ, CAL.—After installing the second municipal lighting and power plant in the State the city has accepted the offer of the Coast Counties Light & Power Company under a new contract for a specified number of years. The proposition submitted by Waldo S. Coleman of the Union Traction Company was accepted by the City Council. Under the terms arc lights for lighting the entire city will be furnished at $4.50 per arc per month.

OROVILLE, CAL.—Electric lights and power will soon be available at low rates for the growing mountain towns of Paradise, Orloff, Stirling and many other smaller points in the northern foothill section. W. T. Hanscom, who owns a great deal of land in that section, has filed a notice of the appropriation of 1500 inches of water to be taken from the banks of Big Chico creek. The water will be carried in an 8-foot ditch to the location of the power house where electricity will be generated.

TRANSPORTATION.

BISBEE, ARIZ.—Surveyors are at work platting the extension of the car line for the Warren-Bisbee Street Railway Company to the city limits.

WALLACE, IDAHO.—The directors of the Hypotheek Mining Company are considering the question of installing a $12,000 electric power plant at the Kingston mine.

LONG BEACH, CAL.—It is understood that work is about to be resumed on the construction of the fourth five-mile division of the Yueneme, Malibu and Port Los Angeles railway.

NEW WESTMINSTER, B. C.—The local and the Ladner, B. C., Board of Trade will hold a conference to discuss the advisability of establishing an interurban line from this place to Ladner.

VANCOUVER, B. C.—The Barkerville Willow River Company is undertaking a survey for an electric road from Barkerville down the Willow river to join the Grand Trunk Pacific at or near Fort George, a distance of 120 miles.

LOS ANGELES, CAL.—The City Council has passed an ordinance which makes Alvarado street a boulevard and forbids a franchise for the proposed cross town car line. A franchise will be asked over either Vermont or Western avenues.

VICTORIA, B. C.—Incident to the transfer of the holdings of the Dunsmuirs to the Canadian Collieries, Ltd., a $1,000,000 power plant is to be erected on the Puntlage river in the center of the Comox coal measuers. The plant will be of 50,000 horsepower capacity.

SAN FRANCISCO, CAL.—The casualty report of the United Railroads for the quarter ending June 30, filed with the Board of Supervisors shows 10 fatal accidents. The list is completed with 347 other personal injuries, attributed to various causes, including assaults, alighting from cars, stepping in front of cars in motion, falling from cars, etc.

GLENDALE, CAL.—The proposed electric railroad between Glendale and Burbank is practically assured. Mr. Huntington has promised the Burbank people that as soon as the right of way and bonus are secured, he will begin work and complete within six months.

PRESCOTT, ARIZ.—The contract for the construction of the Arizona Power Company's low elevation line in Verde Valley, has been awarded to William Nagle and Ed. Kurmier. The line will extend 40 miles from the plant on Fossil Creek to Jerome; $100,000 will be expended.

PORTLAND, ORE.—Archie Mason has been awarded the contract to build the grade for the Mount Hood Railway Company, between Montaville and a point beyond Gresham. Work is to begin at once and will be under the direction of Smith, Kerry & Chase, an English firm of Toronto, Can.

SAN RAFAEL, CAL.—At a meeting of the board of town trustees the petition of W. L. Courtright, a real estate dealer and capitalist, for a street railway franchise of 49 years was ordered to be published and November 21 set for acting upon bids. Courtright purposes to build a street railway traversing the main thoroughfares of the town.

PORTERVILLE, CAL.—The directors of the Holley Electric Railway Company have purchased a power plant site of ten acres from D. Grider, above Springville. S. E. Henley, connected with the line, states that the dam for the power plant is to be located immediately below that of the Globe Light & Power Company and that work upon the construction of the plant would start within a very short time.

OAKLAND, CAL.—Work is well under way on the steel towers which will carry the big power cable of the Great Western Power Company across the channel at the foot of Peralta street. This cable will be hung high enough to allow ships with the tallest masts to pass under it. It is supposed that the S. P. intends to use electric power in its West Oakland shops, and that this is the primary reason for carrying the cable across at this point.

LOS ANGELES, CAL.—The first formal step toward the ultimate construction of a municipal railway from the business center of Greater Los Angeles to the harbor district at Wilmington and San Pedro was taken by the Council this week. By resolution, introduced by Mr. Gregory, the Council requested the Board of Public Works to report the feasibility of and the most practicable route for the construction of such a municipal railway. At the present time the Pacific Electric Company is endeavoring to obtain the franchise from Fifth street to Aliso, to relieve congested traffic on Main street.

PORTLAND, ORE.—One-half the Connell tract, containing ten acres, and bounded by East Twenty-second, Twenty-sixth, Powell and Frankfort streets, has been purchased by the Portland Railway, Light & Power Company, to be used as a site for a factory for the construction and repair of cars and the manufacture of other equipment for the railway lines of the company. President Josselyn of the power company has started East, where he will remain three weeks. When he returns it is believed that he will be prepared to announce the details of the big factory which it is said will be built next year.

TRANSMISSION.

SPOKANE, WASH.—Councilman Nelson is advocating a municipal power plant which is being considered by the city authorities.

LAKEVIEW, ORE.—The Southern Oregon Water Power Company, Fred H. Oliver, president, has made arrangements for installing a plant on Deep creek, 3 miles W. of Adel, to generate 10,000 horsepower.

BODIE, CAL.—Written tenders will be received by the Supervisors up to November 14th, for a 50-year franchise, applied for by the Hydroelectric Company, to erect and operate a transmission line for conducting electric current.

SEATTLE, WASH.—The first improvements to be undertaken by the Hanford Irrigation & Power Company will be the deepening of the main power canal for about a mile at Priest Rapids, to cost about $200,000; work to begin at once.

EUGENE, ORE.—The Eugene Heating & Power Company will resume work on the construction of the $7500 central heating plant. A contract had been previously signed by a Mr. Schafer, who after finishing about one-third of the work, left the city.

OROVILLE, CAL.—Stanward Logue has filed a claim upon 20,000 inches of water in the Middle Fork of the Feather river at a point 200 yards below the junction with the south branch of the Feather river. The water is to be used for purposes of power development.

RED BLUFF, CAL.—T. H. Ramsey, manager of the Cone ranch, has filed a notice of appropriation of water rights of 10,000 inches of the water in Mill creek. It will be delivered from the creek and carried in flumes to the Cone ranch, where it will be used for the generation of electric power.

SACRAMENTO, CAL.—A new wage agreement has been signed up by the Sacramento Valley Power Company, which grants the employes of that company a raise of 75c per day in wages and decreases the working hours from nine to eight per day. The contract provides for a closed shop, the company agreeing to hire all its electricians through the union.

TUCSON, ARIZ.—The Great Western Power Company is engaged in preparations for the construction of a reservoir and power project in the Sabino Canyon. A tunnel will also have to be constructed to divert the waters of the canyon to enable the construction of the dam. W. B. Alexander consulting engineer of the company, states that an expenditure of $1,000,000 to $1,500,000 is involved.

WATERWORKS.

ORANGE, CAL.—In the neighborhood of $1600 will be spent in water development in Santiago canyon by the Villa Park and El Modena water companies during the coming season.

REDLANDS, CAL.—The Domestic Water Company has taken the contract for laying more than 5000 feet of water mains in alleys back of lots and 109 lots will get water supply from this source. Pipe will be laid in a new tract called University subdivision.

TRUCKEE, CAL.—The Truckee Water & Light Company is setting up new posts and stringing heavier wires, preparatory to making a change in the power plant. The dynamo, which has been located one-half mile east of town, will be moved to town and installed so as to work in conjunction with the power house of the Truckee Lumber Company.

GEORGETOWN, CAL.—The Loon Lake Water & Power Company, successors to the old California Water and Mining Company, which has operated the water system on the Georgetown Divide for the last forty years, is making extensive preparations for the building of large storage reservoirs and the erection of hydroelectric power plants on this divide. This work will not be completed for several years.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 16 SAN FRANCISCO, OCTOBER 15, 1910 PER COPY, 10 CENTS

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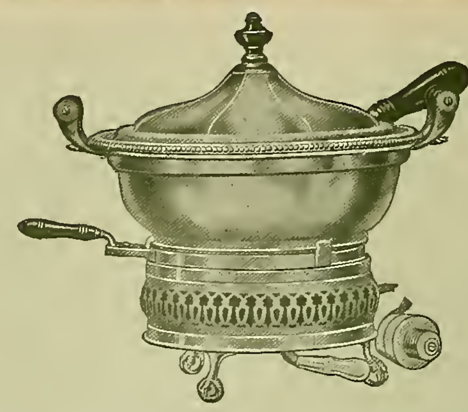

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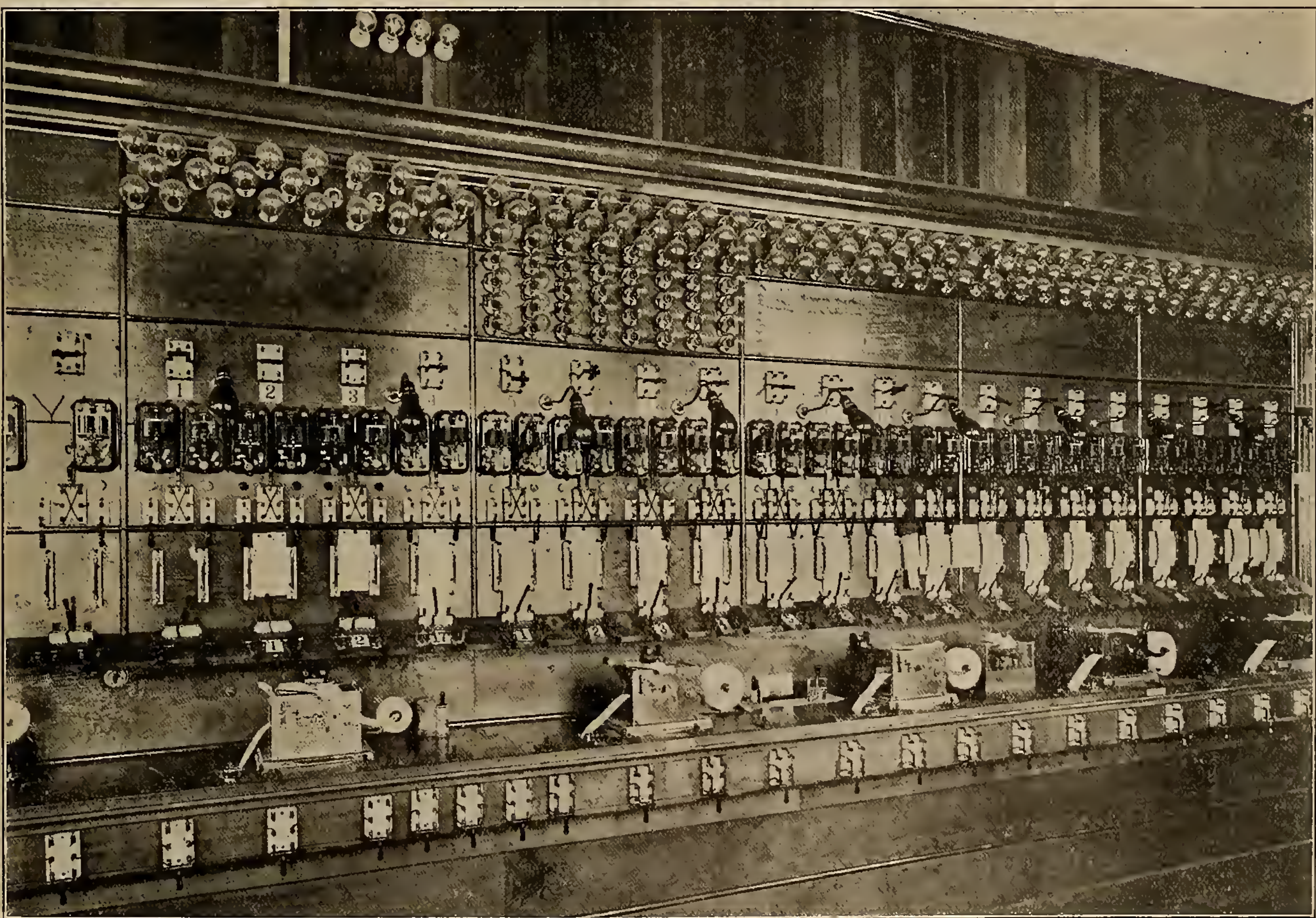
VOLUME XXV SAN FRANCISCO, OCTOBER 15, 1910. NUMBER 16

A MODERN FIRE SIGNAL SYSTEM

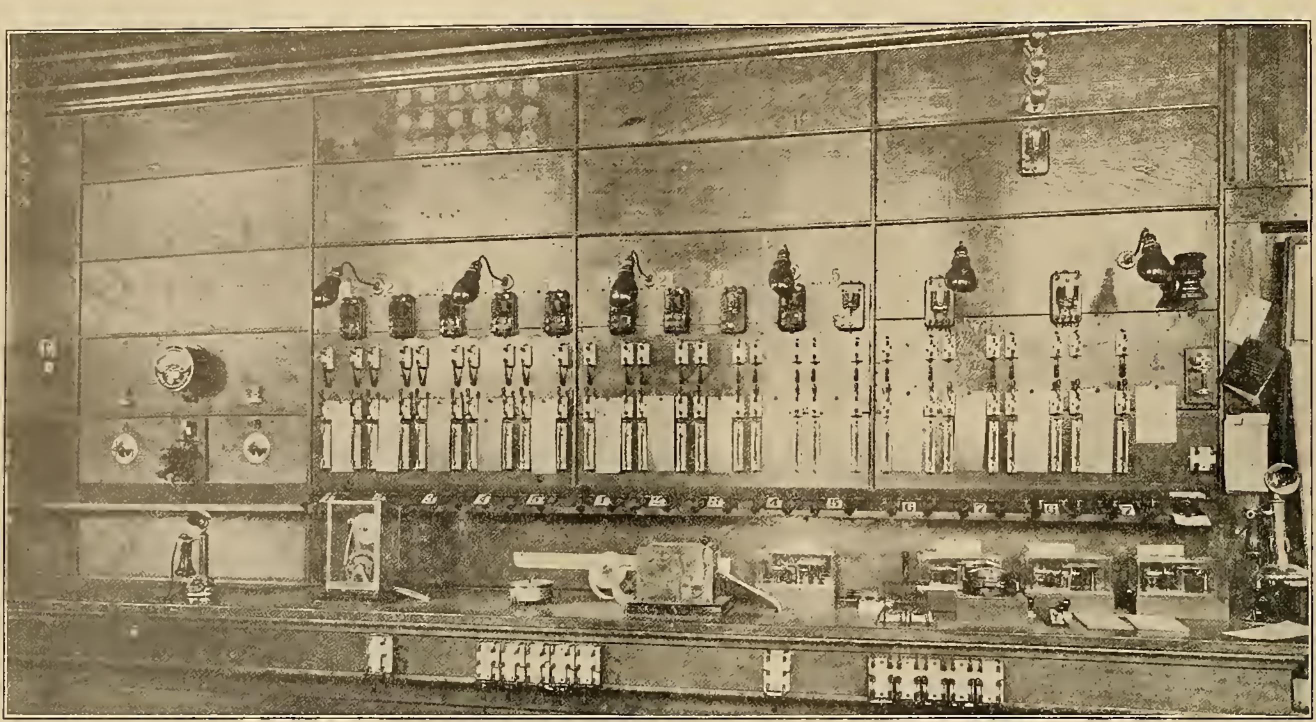
As few people understand how an alarm for fire is received and handled, a brief description of the operation of the system in use in the city of San Francisco may prove of interest. This is an important part of the work done by the Department of Electricity which has invented many improvements and which makes all of the apparatus it uses.

As is well known, fire alarm boxes are installed at convenient street corners throughout the city. By breaking the glass in the front of one of these boxes a key is exposed and used to open the door, thus exposing a hook which is pulled down to send in an alarm. In a few minutes the fire department arrives on the scene ready for work. Just what happens to produce this effect is a mystery to most citizens.

By opening the inner door of one of these boxes it is seen to contain a Morse telegraph key and relay, a shunt switch, a ground switch, and a spring operated gear mechanism which drives a small character wheel having absolutely no electrical connection with the line. Pulling the hook starts this mechanism in operation and causes the character wheel to make four complete revolutions. This character wheel is cut with gears corresponding to the number of the box, a different

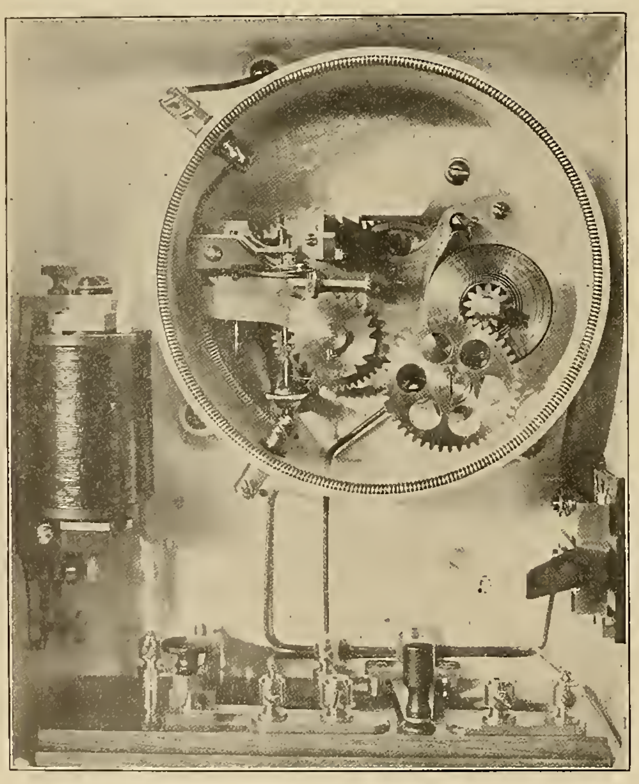


Receiving Switchboard for Fire Alarm Signals.



Sending Section of Fire Signal Switchboard.

wheel being required for each box. For example: box 327 has a character wheel so cut that there are three teeth and a blank, two teeth and a blank, seven teeth



Interior View of Fire Alarm Box.

and a blank. These teeth give an alternate make-and-break contact with a brush connected to the wires leading to the switchboard at the central fire alarm office in the building occupied by the Department of Electricity.

This switchboard consists of a receiving and a transmitting section. The receiving wires are connected to a Morse key and to an automatic register which records the number as a series of dots and dashes. The operator in charge catches the number by ear from the Morse sounder and on receipt of the second round, to confirm the first, immediately repeats it with his master key which is connected to every fire house in the city.

The first blow on the master key automatically releases every horse in the department, strikes all the tappers and at night lights all the engine houses. By the time the horses' collars have been snapped into place, the whole number has been received and the company knows whether it is an inside or outside alarm, that is, whether it is within or without the district to which they go on a first alarm. Subsequent alarms are put in by the fire chief by means of the Morse key in the box.

There are nineteen box signal circuits throughout the city, seventeen being overhead lines connecting 460 boxes and two underground connecting 27 boxes in the main business section. The overhead circuits are mostly No. 12 copper wire with triple braid weather proof insulation and strung on glass insulators. Wherever possible they follow the telephone and telegraph lines, keeping off the power lines, though all boxes are so wired that a hot cross grounds the box without burning the coils. Independent pole lines are used to reach the outlying sections.

The underground circuit, including a 21,000 ft. length now being laid in Market street, are of 40 wire lead armored weather proof cable. All these circuits are interlaced so that nearby boxes are on different lines. An accident to one does not prevent an alarm being put in from another box close by.

Connected to the sending board are fourteen circuits, ten overhead and four underground. These are respectively, five overhead tapper, five overhead alarm, two underground tapper and two underground alarm circuits.

All lines are brought into the building through underground cables, two caring for the overhead system and one for the underground. These cables first pass to the terminal board in order to clear the office for test and to clear the inside fuses. Thence they pass to the main receiving switchboard made up of 19 panels, each of which is equipped with a double pole double throw knife switch for connecting to either the regular or the spare set ;a double pole double throw pole changing switch connecting with the storage batteries; two single pole single throw ground switches; two fuses; two Morse keys and a double throw single pole switch for the galvonometer test for grounds.

There are always two operators on duty at the switchboard, working in three eight hour shifts. There are also three shifts of telephone operators, direct telephone connection being provided to each engine house as well as to the central offices of both telephone companies. These, together with a trouble man insure a minimum of at least four people continuously on duty.

There are three independent power sources for operating the system, two sets of storage batteries supplied with direct current at 110 volts from either the city mains or from a motor generator set in the office and one set of type Q and R Edison batteries. There is also a gas-engine-driven generator to be used as a last resort.

As already stated all the instruments used in this service as well as all switchboards installed at the engine houses are manufactured on the premises in a well equipped machine shop.

The Department of Electricity also takes care of the police boxes for the Police Department. Another important branch of its work is the inspection of all electrical installations in the city, the department approving all specifications, giving certificates of inspection upon the payment of a nominal fee.

Though somewhat handicapped in point of numbers, the department annually inspects from ten to fifteen thousand jobs, its revenue being from $15,000 to $20,000 per year. The department has been an important factor in recommending and enforcing rigid inspections and now suggests that conduits be installed in all public buildings, hotels, apartment houses, moving picture houses and theaters in the city, whether within the fire limits or not.

From the foregoing it is seen that the Department of Electricity is the nerve center of the fire department, all of whose movements are under the control of the electrical operators just as a railroad system is under the control of the chief dispatcher, The executive, head or chief of the Department of Electricity, is Wm. H. Urmy, to whose courtesy we are indebted for the details in this article.

Examination for electrical assistant is announced by the United States Civil Service Commission on November 9, 1910, to fill vacancies as they may occur in any branch of the service. The examination will consist of practical questions in electrical science, practical questions in construction and installation of electrical instruments, training and experience.

NOTES ON DISTRIBUTION POLE LINES.[1]

BY J. C. LAWLER.

Pole lines for distributing light and power seldom receive the attention they should during their construction. This is not due to lack of interest but more to habit—we feel that a line close to the distributing plant is subject to frequent inspection, and any impending trouble can be repaired before serious damage is done.

The distributing pole line is certainly as important as the transmission line. While an interruption to service on a faulty distributing circuit may not cause inconveniences over such a large area, the damages are likely to be greater. We have not only the faults of our own lines to contend with, but other lines may be the indirect cause of one or more deaths with resultant heavy damages. The distributing circuit is not only subject to greater liability to interruption of service from accidents, but the permanency of its location and its reputation for beauty is at the mercy of the public.

Unfortunately, there has been but little improvement in the material for pole line construction, and that which has been placed upon the market is generally mechanically weak in itself or cannot be properly supported. Most of us are still using two separated wires for services when duplex would present a decided improvement, if we could only attach it to a house so it would stay and not pull a weatherboard off or pull out and leave a hole large enough for an attic window. If some genius would only design an insulator suitable for services at the pole so that an inspector on the ground could tell whether the house was connected or disconnected. We need a tree insulator suitable for all sizes of wire, something that will not hurt the tree nor the wire—something cheap—and we need a self-supporting pole, because we do not always have room for stubs nor anchors, and a thin, light weatherproof insulation that in its old age will withstand the primary voltage when crossed with a telephone wire. But, unfortunately, we must do the best we can with the unimproved material and our own home-made devices.

The National Association has done considerable toward standardizing pole-line apparatus. Braces, cross-arms and pins are all being manufactured in standard sizes. Insulators are not standard, and if we could decide upon a certain few types of insulators that would be satisfactory for various voltages and sizes of wire it would not only tend to reduce the price but would give us more prompt shipment and the manufacturers would feel safe in making and stocking up on those types.

For the ordinary 2200 volt line, a porcelain insulator with a groove and a saddle each large enough to carry an insulated conductor of 400,000 cm. cable is satisfactory for practically all distributing circuits. The large groove calls for an insulator large enough for a 4000-volt arc current and is mechanically strong enough for heavy service wires, and yet if we glance through a catalogue of insulators we find several types for 2200 volts, and it is impossible to get better than four months' delivery on any of them.

[1] Paper read at Eighth Annual Convention Colorado Electric Light, Power & Railway Association.

The writer does not believe in building cheap lines. How often have you planned on extending your lighting circuits into a new territory and find that the income does not warrant the expense? And yet you feel that by extending the lines you help to develop the territory and will ultimately have an increased paying business. No doubt you will build, but do not do it at the sacrifice of the pole line. When you increase the length of your spans you increase the maintenance of your lines. For ordinary construction, spans longer than 125 ft. should not be used, and 100 ft. is preferable. Assuming that a residence block is 400 ft. long and is made up of eight 50 ft. lots, and the lots all abut on an alley. If you place poles on lot lines 150 ft. apart you will have trouble sooner or later in getting service wires to your consumers. The erection of barns and other structures on the back end of the lots will not only be obstructions, but quite often one consumer will complain if another consumer's service is over his property. Telephone companies can afford to install 200 ft. spans in new territories, and then place poles half way between when the territory becomes more thickly populated, but when we are limited to 150 ft. spans, any additional poles would give us too short a span and would also bring the poles in the center of a lot. It then requires the rebuilding of a line, the expense of the same going into the pole-line maintenance account in place of being charged against the income of the original consumers. When the income will permit the building of a cheap line, it will generally permit of the building of a good line, if all the expenses are calculated. In building lines, it pays to have careful surveys made.

Poles should be placed upon lot lines extended.

When in alleys, the center of the pole should be about two feet from the property line, which will prevent a four-pin cross-arm from extending into the property.

Lines should be built in alleys as far as practical in order to supply rear feeds and prevent the necessity of services crossing the street.

Lines, when placed on street, should be sufficiently inside the curb line to permit the building of a curb or ditch box.

Poles should be straight, well in line, and painted; a neat-looking pole line helps your standing with the community.

Galvanized hardware is preferable. Above all, do not use brackets, nor permit other companies to use brackets, on your poles. Brackets cannot be regularly placed, and they will not stay on. They are a menace to linemen as they do not allow room to work and endanger his life.

The writer has found that a cross-arm to be mechanically strong must be at least 3½ in. by 4½ in. In order to allow the lineman room to climb a pole between conductors, a 28 in. space or more must be left. When the center space is 28 in. with pins 12 in. apart and 4 in. between the end pin and the end of the arms, it will make the arms of the following length: 2 pin, 3 ft, long; 4 pin, 5 ft. long; 6 pin, 7 ft. long; 8 pin, 9 ft. long.

Cross-arms are cheaper when purchased in even foot lengths. The National Electric Light Association standard is 14 in. pin centers, but the difference in price warrants the use of the 12 in. spacing.

It may be advisable to step transformer poles, but when steps are used, the lowest step would be 7 ft. from the ground, in order to prevent the small boy from climbing the pole.

No. 6 wire has undoubtedly been found to be the smallest allowable, on account of mechanical strength. No. 8 is preferable for service wires, as it throws less strain on the house brackets. Each house in a residence district should have its individual service wires. When the house is disconnected, the service can then be disconnected at the pole and the service dropped from the insulator down around the pin. This permits your inspector to determine as to whether or not a house is connected. The system of running a bus bar arrangement on the back of the houses invites the occupants to connect themselves, then you not only lose the income but lose the current.

It is important that a transformer record be maintained, and maps showing the lines. The following system has been adopted by the writer, which has proven effective.

The maps are drawn on the back side of tracing cloth, each circuit being drawn separately and shows the location of lines, the position of the conductor on the pole; certain signs are used showing the location of lightning arresters, size of wire, location and number of transformer, etc. The map also indicates the ownership of the poles and shows whether or not the line is primary or secondary. These maps are cut in sections about 10 inches by 12 inches, and kept in book form. The tracing permits blue prints to be made, and the transformer numbers are written in lead pencil to facilitate erasures. The small sections make the map easy to handle, and obsolete sections can be replaced without redrawing the whole map. A transformer record is maintained in the office by a card system. Each transformer is indicated by a card showing all the name-plate data, number, location, date installed, removed, and when purchased. Back of this transformer card is an address card, giving the address of the consumer, dates connected and disconnected, meter number, its installation and approximate demand; each installation having an individual card. The approximate demands are added to determine the load on the transformer. This arrangement prevents overloading of transformers and gives the engineer a comprehensive idea of what is going on over his circuits.

A complete pole-line record can hardly be maintained with any degree of satisfaction, and the writer does not believe that such a record is necessary. Any proposed change in a line or improvement in construction cannot be done except by direct inspection of the premises. However, when poles are numbered and a record kept in the office of the date of installation, with the kind of preservative used, some information can be gained regarding the life of a pole.

It is the usual practice in outlying districts to run long secondaries, using as few transformers as possible. This is certainly an efficient arrangement, provided the secondary line is constructed so as to be used for primary current at a later date. The top arm should not be less than a four-pin, the secondary wires

occupying the pole pins, and as the load increases the secondary can become a primary extension and a new secondary line run on an additional cross-arm. This leaves two pins vacant on the top arm for an arc circuit. Under no circumstances should the primary and secondary lines be on the same cross-arm. When three-wire secondaries are run, a four-pin cross-arm is required. In my experience, I have found we have little use for two-pin arms. When lines are run in alleys, it is not advisable to use an arm longer than a four-pin when the arm is placed with its center on the pole, or the arm will extend over into the property line and sooner or later cause trouble by interfering with buildings, and you are also likely to have additional trouble on your hands if the line falls into private property. The system of placing arms off center cannot be recommended, as the pole will invariably lean and lines cannot be drawn taut without twisting the poles.

Lightning arresters should not be placed upon the same pole as the transformer or fuses. All ground wires should be equipped with a convenient device for disconnection at a point about twelve feet above the ground. An ordinary screw connector is suitable for this, and a lineman who fails to disconnect the ground wire before going to the top of the pole is negligent.

Three-wire secondaries in the resident district may save copper at times, but the extra room required and trouble in balancing largely offset the advantages. There are ammeters on the market, equipped with split current transformers, which are very convenient in testing the balancing of three-wire transformers while under operation. This current transformer can be clamped by a lineman over the conductor to be tested, and the amperes are indicated directly to an inspector on the ground. A three-wire transformer may have one side considerably overloaded and the other side very lightly loaded, which might result in a transformer destroying itself even when the capacity of the transformer exceeds the total connected load. If you will take pains to make tests on your three-wire systems, you will find some startling results which cannot be readily accounted for. The ampere readings on the three legs will not always check up, and one side will be carrying considerable more than its share of the load, which will vary with the hour, day, season and year.

If a grounded system is used either in a two or three-wire system, care must be taken that the grounded conductor does not pass through the series coil of the meter. Otherwise a ground on the consumer's wiring will shunt the meter and cause it to run slow. Some companies are using low-voltage lightning arresters on their secondary circuits, which obviates this trouble and several others, but may not afford the same degree of safety from high voltage.

When transformers are connected in parallel, each block should have its individual set of transformers. There is little to be gained by carrying secondary wires across a street in order to make parallel connections. The set of parallel transformers should, when possible, all be connected on one set of fuses, and this set of fuses should not be on the same pole as lightning arresters or transformers. The single set of fuses permits one man to fuse up while the transformers have a full connected load, otherwise a man is required to each set of fuses, and all must put fuses in by a predetermined signal, which can only be done with a certain degree of success. While transformers may operate perfectly in parallel and deliver better voltage, the writer believes that for the ordinary residence district a single transformer, located in the alley near the center of the block, connected to a two-wire secondary system, will give less trouble and can be operated satisfactorily to the consumers. The extra cost of copper is largely offset by the decrease in transformer losses and expense of maintenance.

Each year we see more galvanized hardware on our pole lines. "Cross over" brackets present a better appearance than the buck arm construction for services. Metal clamp-pins are replacing the wooden pins to a certain degree, but are generally considered too expensive for ordinary construction. The clamp-pin quite often prevents a cross-arm from splitting and is particularly adaptable to old arms. They not only give an extra strength to the arm, but are adjustable. Guy shims should be used, as they prevent the guy from cutting a pole and save some slack accumulating. Guy clamps and hub guards on an exposed pole present a substantial and permanent appearance. When a pole is installed in a substantial, workmanlike manner, a property owner may hesitate in asking you to move it.

Distribution systems in the business district present a different condition from those in the residence districts. The lines in the business districts are liable to be old, and we are hampered by other companies' lines. We have but few choices of locations for poles and our lines should be a considerable distance from buildings and fire-escapes. We must also be prepared to furnish several different kinds of current at any point in the block. The poorest line construction can generally be found in the business districts, for the reason that no general plan has been followed.

One company has adopted a system for alley-pole construction in the business districts which the writer wishes to describe. In this instance several residence lighting circuits had to be carried on the same pole-line through the alley, so that a bridge construction work was adopted.

The company's bus bars for distributing service carries 2300 volt, three-phase, three-wire, 60 cycle current, and each of the distribution circuits left the plant three-phase with individual panels and automatic oil circuit breakers. The principal feeders were equipped with three-phase motor control regulators.

In this case the alley was twenty feet wide and the poles were placed with their centers seventeen feet apart. The arc circuits were all placed on the top arm, as they would to a certain extent act as a screen protection to the other circuits from falling lines.

The second arm was devoted to the 2200 volt, three-phase lighting circuits, and the third arm to 500 volt direct current power circuits, police alley lamps, and the secondary distribution which requires six pins.

Each block is considered as a unit; that is, the transformers in adjoining blocks are not connected in parallel and each block has at least three single-phase transformers, ratio of 2200 to 220-110, connected

three-phase delta on the lighting circuit. Each set of three transformers has its own sub-circuit—the sub-circuit having three fuses of its own for the block, all located on one fixture at the end of the block. There are no individual transformer fuses.

The drawing of the fixture indicates that the transformers are supplied from circuit four by means of the sub-transformer circuit T4 on the top arm.

The electrical connections are shown in the wiring diagram. Thus it will be seen that,

110 volt, single-phase, can be furnished from any adjacent pair, including A and F.

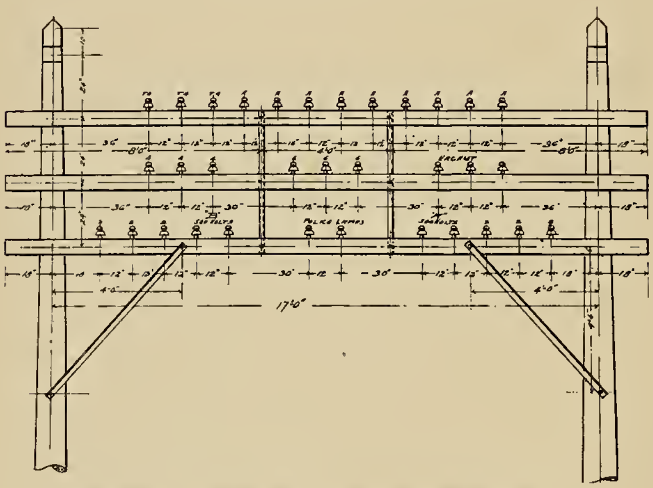
220 volt, single-phase, can be furnished from AC, CE or EA.

110-220 volt, three-wire, from ABC, CDE or EFA.

110 volt, three-phase, from BCD, DEF, FAB or BDF, preferably the latter.

220 volt, three-phase, from ACE.

Thus the company is able to furnish any of the current mentioned for single or three-phase motors, either 110 volt or 220 volt, or single-phase 220 volt for rectifiers, and 110 volt or 110-220 volt current for lighting, all off the same transformers in any part



Bridgework Construction for Alleys in Business District

of the block without going to the expense of additional line construction work. In one instance three 25 kw. transformers were used for lighting, and a 50 horse-power, three-phase motor was connected to the same transformers. As the motor did not run during the main lighting hours, no ill effects were noticed except when starting or stopping the motor, when a slight variation in voltage could be noticed.

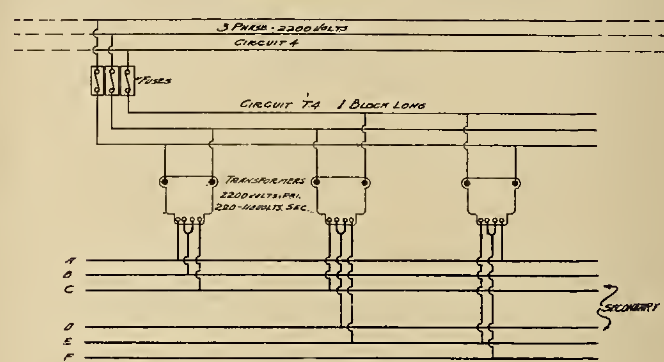
The principal objection to this plan of connecting is the six secondary wires required, but any other system giving the same number of combinations of voltages would require even more secondary wires. The system amounts to a double three-wire system, so that the conductors are not necessarily so large as would be required in a single three-wire system. The transformers are placed in the alley so as to divide the block in approximately three equal parts and each transformer supplies the single-phase current to the nearest territory, which allows little drop in line secondary.

The fuses are readily accessible and the whole block is fused at one time, thus avoiding the difficulty of fusing paralleled transformers with individual fuses when under heavy load.

For protecting the secondary from high potential any one leg could be grounded but the writer prefers to use six low-voltage lightning arresters.

This system of connecting has been in use for some time and has proven very satisfactory. It is certainly a great relief to be able to furnish a consumer with any of the selected standard voltages without constructing some makeshift arrangement for each individual case. In addition, it reduces the transformer core losses to a minimum and reduces the construction cost by using fewer transformers.

Several of the poles are occupied jointly by two or more companies. The street car company's feeders occupy a position on the top gain on one side of the alley, while the opposite side was given to the city's fire-alarm system. It is better for the fire-alarm system to be below the lighting conductors, but due to local conditions this was found impractical. The arrangement of the circuits is such that the secondary lines are three feet from the building line and the light



Wiring Diagram and Transformer Connections for Light and Power Circuits in Business District.

potential circuits are at least four feet, six inches, from the building line, so that any one leaning from a window would not be likely to come in contact with any high voltage current except at points where the transformers are suspended. The services are taken from a six-pin arm mounted on the pole at right angles to the bridge arms.

Distributing circuits covering a large area present greater difficulties in finding trouble, but the plant equipment and necessary room in the plant is considerably reduced. In one case fifteen single-phase lighting circuits, requiring thirty-three feet of switchboard, was replaced with six three-phase circuits requiring five feet of switchboard. The number of conductors leaving the plant was reduced from thirty to eighteen with a corresponding reduction of cross-arms, pins and insulators.

The resident three-phase, 2200 volt circuits are only carried three-phase through the main alley a short distance. All branch circuits are taken off single-phase so as to keep the main three-phase circuit practically balanced.

In order to more quickly locate a short circuit, the main branches have been equipped with pole-line oil switches, so that the branch may be readily cut out for testing purposes.

GENERAL POLICY REGARDING PIPE EXTENSIONS.[1]

BY C. A. LUCKENBACH.

At the sixteenth annual meeting, the secretary of this association presented a notable paper on "Corporation Regulation," in which, after describing the attitude of the public press with reference to public service corporations, he makes use of the following language: "For all this pilloried condition the present corporations and their predecessors in interest have themselves so largely to blame, that a new method of treating the public must be created to restore them to the favor in which they were once held."

In studying this paper and looking into the department in which I am particularly interested for "the original sins," which our secretary calls "in many instances equivalent to the action of get-rich-quick concerns," I am involuntarily drawn to a consideration of the policy regarding pipe extensions and the effect it has on the public pulse and the capital of "good will" of the corporation.

The use of gas in the household is no longer a luxury, in fact it has long since ceased to be so. Even the courts of California have recognized the use of gas as such a necessity as comes within that provision of our civil code, which makes the salary of a wage earner attachable for its use. So generally recognized is this necessity that the home builder has long since reached the point where he is unwilling to enter upon the improvement of property, until he knows to an absolute certainty that when he accepts the keys to a finished building, that building is reached with the pipes necessary to furnish those who occupy it with gas for any purpose desired. In a word, the person who is willing to live in a house which is not supplied with gas is the rare exception. And has he not the almost undeniable right under reasonable conditions, of demanding the same?

When the framers of our state constitution inserted that provision which gives an individual, or a company, the right to enter upon the streets of any incorporated city or town for the purpose of supplying the inhabitants thereof with gas, without specific franchise, but "under the direction of the superintendent of streets, or other officer in control thereof, and under such general regulations as the municipality may prescribe for damages and indemnity for damages," they did so not for the purpose of relieving the individual or corporation accepting its provisions of any burdens, but with a different object in view. It was sought to remove the possibility of oppressive monopoly in handling this and other necessities of life, and in accepting it the individual, or corporation, acquires not only its privileges and its benefits, but its obligations as well. That its object was reciprocal is clearly evidenced by the fact that it retained within the power of the municipality, within which this right or privilege was to be enjoyed, the right to establish and fix the rates to be charged for the service rendered. Whether this provision is a wise one, for either the best interests of the company, or the consumers, owing to the political influences which surround our various municipal authorities, is questionable, but it is still a fact that the provision is in force, and in its enforcement the voter, whether he be consumer or not, has an influence and a power. And this influence and this power he will continue to use as a leverage for securing those rights which he believes he should possess and which he is not able to freely obtain. One of these rights is the ability to secure liberal extension of mains and installation of services upon the application of would-be consumers. And should he not be able to do so, both for the best interest of the consumer and the company? Perhaps the difference of opinion arises from the viewpoint of liberality, which we all know is vastly influenced by whether we are the giver or the receiver. But there must be, and is, a common ground upon which both the company and the consumer can stand in their definition of liberality as applied to these extensions. It is not a difficult matter for a manager to determine the cost of a proposed gas extension, to estimate the probable consumption along the line of such extension, and to decide whether or not it will be a paying one from the date of its installation, and upon such decision approve or reject its construction. Such might, and would be, the cold-blooded proposition from the standpoint of obtaining "all the traffic will bear," but is it the broad and wide policy necessary for the upbuilding of a strong, vigorous and healthy business upon which the investor can depend for good or even fair returns for a period of years? Or is it such a policy as will earn or entitle the company to expect the good will of the general public? In a fixed or settled community, where newspapers are published once a week, where the fact that John Jones has put a back porch on his house is a news item, and where the building of a new house is an event, and not an everyday occurrence, such it might be. But we are dealing with conditions as we find them on the Pacific Coast, where, even before the fires of a terrible calamity had been extinguished, the pluck, energy, courage and grit of the inhabitants had caused them to begin clearing away the debris and to commence the erection of a new city, more elaborate in conception and accomplishment, more beautiful in its architecture, and more secure in its construction, than that which the elements in a few short hours had swept away. We are dealing with conditions as we find them in communities where the orange groves or open fields of to-day are the settled residence sections and well-built-up communities of to-morrow, and such conditions exist in practically every portion of that territory covered by the membership of this association. Why should the pioneers of coming communities be compelled to ask in vain for the use of such necessities until the territory becomes highly remunerative, except it be upon the principle of obtaining "all the traffic will bear"? The acceptance of the privilege to enter upon the streets of the thickly-populated portions of a city carries with it the obligation to extend the service, under reasonable conditions, to less thickly-settled but rapidly and steadily growing sections as well, and no surer means of securing the good will and co-operation of the desirable public exists for the public utility corporation than by adopting this policy. In some cases such a policy may work a hardship for the time being, but in almost every case the result will justify the means and eventuate in added benefits to the company.

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, Los Angeles, September, 1910.

It can hardly be questioned that the future security and stability of the capital invested in public utility companies depends to a large extent upon the good will of the public. That the public is fickle is not to be denied. Nor can it be denied that this fickleness operates in almost every case against the utility corporation and not for it. It is a condition which the corporation manager knows to exist, which he must expect to meet and which he must be prepared by wise policies to combat and overcome. What surer method is there of reaching the general public, of bringing a gas company to its favorable consideration and of securing a hold upon the people, than by such liberal extensions of mains and installation of services? The writer believes there is none. As to the building upon that foundation, after it has once been laid, is a matter which is not within the province of this paper. There is, however, an element of this discussion which is of vast importance to the utility corporations, and one with which some companies will be compelled to reckon at a future day, and which, in the writer's opinion, is bound to cost more than is ever obtained. I refer to the matter of demanding or accepting bonuses for extensions of mains or installation of services. No public utility corporation should permit itself to be placed in the position of either accepting charity, or of demanding public contributions, toward the building of its plant, or distributing system. An applicant for the service which we sell is either entitled to such service free, or he is not entitled to it at all. If he is entitled to it, he should have it without the exaction of one penny of bonus, or other consideration. On the other hand, if under such a liberal and generous policy as has hereinbefore been referred to, he is not entitled to the entension, he should not be able to obtain it by a thinly-veiled species of bribery.

The incorporators and officers of a gas company know full well that money, and lots of it, is necessary for the building of a works and distributing system to supply the community which it desires to enter, and it should be prepared to meet the demands which it has undertaken to supply and meet these demands upon such a basis as will permit the company to retain the respect of the public. The only basis upon which the collection of these contributions can stand, is that might makes right. The commodity which we sell—gas—is the property of the company until it leaves the meter, and all changes are based, or should be based, upon a fair return upon the investment in a system extending to the outlet of the meter. Upon what basis then can the cost of building the lines to the meter be charged to the consumer? And in this State, where rates are fixed by the municipal authorities, does it not come dangerously near a violation of law, or at least evidence such a contempt for not only the evident intent and purpose of the law, but the right of the consumer, as will eventually cause an uprising which will do a thousand-fold more damage than could possibly be offset by the aggregate amount of the bonuses collected. The time has gone by when the corporation, oblivious to common sentiment and unmindful of public opinion, can force an objectionable and unjust policy upon the people. The bonus-built company will contend that where such contributions are obtained, they are made by tract owners to advance the value of their lots and the salability of their property, and that they are willingly made. It is true that added value is given to the real estate by the laying of gas mains, and it may be true that the real estate owner is seemingly willing, and often offers, to pay for the added value, but is it not equally true that the extension has added no more value to the property of Mr. A., who pays a bonus, than it has to the value of the property of Mr. B., who has made no contribution to the fund for the building of the system? And is it not equally true that the seemingly willing contributor to the extension of the system is willing because he must be? But is he a willing contributor when he casts his vote in favor of a low and often unjust rate, or is he influenced in his vote by his desire to even the score with the company for making him pay for what his neighbor has obtained free?

On what basis of effective argument, with what evidence of injured rights, can the company which has built its system, or any material part of its system, on bonuses, go before the public declaring that a given rate does not afford an ample return on the investment made? Is the company which accepts bonuses, gratuities and charities, able to go before the court of public opinion, or the court of equity and justice, with "clean hands," and show that any rate is too low to afford fair returns on capital invested? Can the bonus-built company, with justice to itself, ask the consumer to build its system, and then pay a rate based upon a return upon the capital which the consumer himself has donated? It appears to me that the time for such policies has gone by, and the manager who adopts such a policy stores up trouble, which, with the present temper of the voting public, is bound to react to the ultimate injury, not only of the company which he represents, but of all other companies engaged in similar business, as well. Truly this is one of the sins which have been called "equivalent to the action of the get-rich-quick concerns."

The defense that bonuses are paid willingly is too often a subterfuge, too often an attempt to conceal a determination not to extend mains unless a bonus is paid; in other and plainer words, a determination to build a system by public contributions and no other. Too often the company accepting bonuses permits would-be consumers right at the doors of its system to go without this necessity until a bonus is paid, and often when such action is in direct violation of law. What defense of any kind, except that which is expressed in the words "the public be damned," can a company, operating within California, make, when it charges a bonus for an extension to supply a would-be consumer within one hundred feet of its main. None, except that it takes advantage of the lack of legal knowledge upon the part of the average inhabitant. And yet it is done, and this violator of the law appeals to the majesty of the law and asks the assistance of the same law it has violated in effect to protect it in its rights. Will it do so? Can he reasonably expect it to do so? What security can you, or I, honestly expect from the enforcement of the law which we treat with contempt? An eye for an eye,

a tooth for a tooth, is the dictum of the old Mosaic law, and it is the law of the present day business world. When we apply it to others, why should we not expect it to be applied to ourselves? It may be true that "good will cannot be created in favor of the corporations by the corporations' good deeds, because such deeds are misunderstood and misconstrued," but that is no reason why the corporation should wilfully carry on a policy which it knows is unjust and oppressive, and which is bound to neutralize the effect of any good deeds which are performed in its name. The time will never come when all of the public will treat corporations justly, nor will the time ever come when all the corporations will treat the public justly, but the time has come, when both the corporations and the public must assist in finding a common ground upon which each can stand with confidence in the other. Corporations are just as necessary to the public welfare as the public patronage is to the corporations, and by urging the adoption of acceptable policies and the eradication of unwise and objectionable policies, each of us can do his share toward securing this highly desirable result.

TELEPHONIC DEVELOPMENT OF COLOMBIA

The Republic of Colombia has an area of 486,000 square miles and a population of over 4,000,000, but its telephonic development in number of telephones and quantity of material is less than that of the ordinary city of the United States. No national statistics upon the subject are obtainable, but it is known that with the exception of a very few of the larger cities and of a few mining camps the entire country is without telephone facilities.

This condition is explainable in a measure by the wide use made of the telegraph system, which in Colombia is well developed and has lines reaching to isolated villages and communities. This system was built by the National Government and is under its special protection and supervision, as well as under its censorship. As the minimum rate for telegraph messages is equal to only 2 cents American currency per word for any distance, extensive use is made of the system.

In this consular district there is but one public-service telephone system. It is in the city of Cartagena and is exclusively owned by F. & A. Franco, local merchants, by whom it is operated as Empresa de Telefonos de Cartagena. This system was established in 1899 and is managed as a private enterprise under an exclusive concession for twenty-five years, granted by the National Government.

The company is not associated with any other in this country in business or by wire connection and it does not possess or operate any wires outside of the city and its immediate environs. There was formerly an extension to the village of Turbaco, 12 miles distant from Cartagena, but this extension has been discontinued on account of the limited use made of the wire and the difficulty in maintaining it intact and free from molestation by unauthorized parties. Connection with the telegraph lines of this city for short distance telephone messages has been occasionally with fair success.

The company maintains a central station and separate business office in this city. Its employes, all men, number 5, and consist of 2 central operators, 2 line runners, and a repair man. There are 100 subscribers to the service, all wires running direct to the central station, there being no party wires. No charges for installation are made to the subscribers within the walls, Cartagena being a city of limited area. For subscribers in the extensive suburbs, erected in recent years outside the walls, installation charges are made for the length of wire from the wall to the subscriber and for the labor cost of laying it.

The hours during which the use of the telephone is permitted are 6:30 a. m. to 10 p. m., while the number of calls is unlimited; the total average is 2480 daily, or 905,200 annually.

The monthly charge for service is $3 for ordinary telephone and $5 for long distance. The latter are of better appearance, are equipped with adjustable extension transmitters, and while there are no long distance connections there is greater clearness in messages.

All the material and apparatus, except 6 telephones purchased in 1909 from Germany, are of American make. (Western Electric Company.) They are all older style, necessitating ringing up the central office in addition to removing the receiver from hook. The principal ones in use are of old-fashioned appearance, with short unhinged transmitter; the other types are the long-distance telephone with transmitter at end of a hinged extension arm and a few of the desk type. The 18 miles of wire are of copper. The iron wire formerly used did not last in this climate.

A private system is operated by the Cartagena (Colombia) Railroad Company, with 15 long-distance telephones, without central office or switchboard, connecting the offices of the company with its stations, workshops, and wharf in this city and with the offices of the local aqueduct company, which is under the same general management. An extension wire reaches to Kilometer 15, 9 miles distant. These are also Western Electric telephones of the older type, but give satisfactory service. The 13 miles of wire are of galvanized iron No. 10.

There are telephone systems in Bogota, with connections reaching its suburbs in Medellin, in Bucaramanga, in Barranquilla, and in Santa Marta. A few private series of telephones without central switchboard are installed in certain large mining camps and haciendas.

It is probable that well-directed efforts to place telephone systems would pay, but the development would not be rapid and the first orders received would be moderate in quantity. To secure this business the energetic work of a competent traveling representative, who could visit the different communities and personally urge the many advantages of telephone facilities, would be required. It is hardly considered probable that more than a few of the cities now unequipped could be persuaded, even by such a representative, to install complete systems, but there would be a fair market for single or party lines without central stations, some of which would form a nucleus for more complete systems in the future.

REPORT OF COMMITTEE ON GROUNDED SECONDARIES.[1]

At the last meeting of the Association held in Denver, Colorado, your committee was appointed to gather as much data and information relative to the grounding of secondary circuits and the results of doing same as was possible, for the purpose of assisting in formulating any necessary rules for the protection of life and property on circuits carrying electric current for lighting and power. A relatively small amount of information was obtained, but your committee believes that a more aggressive campaign taken by your association would result in a more intelligent and closer study being made by the Member Companies on the subject, which would result in a more uniform system of power and light distribution and protection of same against life and property.

A circular was forwarded to each of the Member Companies containing the following thirteen questions:

(1) Name of company.

(2) Do you ground your secondary alternating current systems?

(3) Up to what voltage between ground and line?

(4) On polyphase circuits, at what point do you make your ground connection?

(5) How do you make a ground connection?

(6) Please give record of tests you have made as to resistance and permanency of ground connection.

(7) Please give full history of fatalities and serious shocks occurring on your secondary circuits, and full details as to voltage and conditions under which shock was received.

(8) Please give same data in regard to fires which have occurred on your secondary circuits.

(9) Since your secondaries have been grounded, have you experienced any increase in transformer breakdowns, or any other increased cost of maintenance?

(10) Since your secondaries have been grounded have you noticed any increase in the number of fires due to electric current in the customer's premises?

(11) As a result of experience, do you consider the constant menace of a possible shock of 250 or 300 volts on grounded circuits to be greater or less than the menace due to the breakdown of transformer or crosses between secondaries and high potential lines?

(12) Please give your opinion of the limiting voltage which the rule should specify "must be grounded."

(13) If the secondary of your system is **not** grounded, please give your reasons for **not** doing so.

Replies were received from 17 companies—replies to each of the questions being as follows:

One company only grounds everything up to 460 volts. Another company grounds single phase circuits only up to and including 250 volts. Another company has grounded part of their system for experimental purposes, in order to study the relative protection afforded. The remaining companies report that they have not as yet grounded any of their secondary circuits.

One company reports grounding of their polyphase circuits up to 460 volts, the ground connection being made in the center of the secondary circuit in one transformer on closed delta connection. Another company reports the grounding of their three-phase 440-volt secondaries through spark gaps. Several other companies are considering the grounding of polyphase circuits at the neutral of star connected transformers and open delta connected transformers.

Of the companies using grounded connections, the methods of grounding used by one company is by imbedding a tin copper disc or close spiral made up of No. 4 B. & S. wire tinned, below water level in a bed of ground coke and where water level cannot be reached, in permanent damp earth. Wherever possiple the grounds are placed by this company near a stream.

Another company reports that wherever possible ground connections are made to water pipes, but where this is impractical or impossible, ground plates are imbedded in coke dust.

The rules of another company for ground connections are as follows:

The secondary ground connections should be made to a thoroughly grounded water pipe system, or to a first class ground plate installation, or if that is not available, three pipes not less than 1 inch in diameter may be driven into the ground not closer than 10 feet apart, each pipe not less than 5 feet long. The ground wire should be connected to each pipe independently.

The practice of another company is to use iron pipe where same can be driven into the ground; where this is impractical an excavation is made and coils of wire buried.

No reports were received on any ground resistance tests being made by the companies using grounds, but for the information of the Association the committee wishes to state that during the summer of 1907, Prof. E. E. F. Creighton, lightning arrester expert for the General Electric Company made a series of tests on different types of ground connections at the Silverton substation of the San Juan Water & Power Company at Silverton, Colorado. The resllts of the test may be found in the proceedings of the American Institute of Electrical Engineers, Vol. XXVII, Part I, entitled "Measurements of Lightning, Aluminum Lightning Arresters, Earth Resistances, Cement Resistances and Kindred Tests."

The tests in a general way consist of the following:

1. Variation of resistance with depth (dry earth) using iron rod driven in the ground.

2. Variation of resistance with time after salting.

3. Measurement of resistance between pipe in variable multiple groups.

4. Measurement of resistance between different points on the system to determine ground resistance.

From the results of these tests and subsequent observations, it is clearly shown that earth connections are more or less unreliable unless extreme care is used in selecting thoroughly moist earth where pipes or buried copper plates or discs are used, and to in-

[1]Read before the Colorado Electric Light, Power and Railway Association, at its eighth annual convention, held at Glenwood Springs, Colo., September 21, 22, 23, 1910.

sure good ground connection provision should be made for keeping these grounds thoroughly grounded by the application of a brine solution.

A ground connection to water pipe system appears to be the most desirable, but with a large number of the Member Companies it is quite probable that such a favorable condition does not exist, so that grounds of other types must be provided.

One company reports the occurrence of a fatal accident caused by contact between the primary and the secondary circuit of a distributing system, the primary voltage being 2300. Another case was reported by the same company of a consumer receiving a severe shock from a 220 volt circuit due to a defective socket. They report that the test made in this case did not show any contact with the primary circuit, but that the effect of the 220 volt shock was sufficient to render the party unconscious. In none of the above cases were the secondaries grounded.

Another company reports a serious accident to an employe of a power customer who placed his hand upon a 440 volt, three-phase induction motor. The cause of the accident was investigated very thoroughly, and it was found that a discharge of lightning broke down the insulation between the primary and the secondary leads through the transformer case; the primary potential being 17,000 volts and the secondary being 460 volts. The secondary circuit in this case, was not grounded and neither was the frame of the motor. The current from the primary circuit in this case continued to arc over after the discharge of lightning, and was in this condition when an employe of the power user placed his hand upon the motor. The man's right arm and left leg were so badly burned that amputation was necessary. The transformer cases in this installation were grounded by placing same upon the earth in the transformer station, but neither the secondary circuit nor the motor frame was grounded.

The ground connections of the transformer cases, however, were so poor that there was sufficient potential between the motor frame and the ground to cause the severe burning mentioned above.

Another company reports severe shock received from breaking down of transformer insulation between the primary and the secondary, which they claim has been eliminated by grounding of secondaries. The primary potential in this case being 13,000 volts and the secondary being 115 volts. Only one company of those reporting attribute the starting of fires to contact of the primary with the secondary or ungrounded secondaries. This particular case was caused by a severe storm tangling up the primary and the secondary on a 2300 volt distributing circuit. They further report numerous other instances where fires were started by the primary circuit becoming crossed with the secondary.

No additional trouble or transformer breakdowns have been noticed by the companies grounding their secondaries. One company reports that damage to transformers has been decreased. Another company reports that since grounding their secondaries that lightning will sometimes jump from the primary wires outside the transformer to the case and from the case to the secondary and thence to the ground. They state that in some cases, the arc will hold until the fuse blows, and in another case the arc will hold for a few seconds and break without blowing the fuse, and in no case have they noticed any damage done to the transformer.

None of the companies report any increase in the number of fires since grounding of secondaries.

Very few answers were received to the question as to the greater or less menace of possible shock due to the grounding of secondaries. One company states that on mill and power work the constant menace of shock due to grounding secondaries insures better installation and is emphatically less than the danger to life and property on ungrounded circuits liable to transformer breakdowns, crossing between secondaries and high potential lines, and the possible continued existence of unknown grounds putting full circuit potential from the other side of the circuit to ground, instead of only part of the full circuit potential being present intentionally, and provided for.

Another company feels certain that the danger of transformer breakdown and contact between primary and secondary is far greater than the danger of shock in the difference in potential between wires and ground. Another company considers the menace greater. One company states that in their opinion all circuits rated at 500 volts should be required to have some point grounded, giving as much less voltage as possible. Another company reports that the limiting voltage that must be grounded should be 150 volts. Another company reports that lighting secondaries up to 220-250 volts must be grounded. Another company asks why there should be any limit. Another company states that if they were convinced that grounding was best, that they would ground 250 volts. Another company gives 300 volts as the limit that should be grounded.

There seems to exist considerable indecision and varieties of opinion for not grounding secondaries. Several of the companies state that they have talked the matter over but have not as yet decided to ground their secondaries, but expect to do so in the near future.

Other companies give as a reason for not grounding that they have never had any trouble with ungrounded secondaries, and not having experience with grounded secondaries, are not in a position to decide as to the advisability of grounding. Several other companies are not thoroughly convinced that grounded system is the best. One company is uncertain as to the benefits of grounding. Another company states they are using 110 volts on their secondary circuits and consider this, together with a clear line, as the best insurance. Another company is awaiting the results from other companies who are grounding. Another company states that grounding secondaries increases fixed losses by forcing individual circuits for lighting and power, and thereby also increases overhead and transformer investment. Another company states that they have not grounded chiefly because there has been a great difference of opinion regarding the advisability of so doing.

Your committee wishes to make comments on several points brought out in the answers received to questions sent out, among which one is of considerable

importance to power and lighting companies that are operating in the mountainous districts of Colorado, and who are supplying and distributing power over high potential lines where the transformation difference of potential is relatively high, and in which the menace of breakdown is relatively greater than the lower transformation.

In two cases reported, severe shocks and injury was sustained due to breakdown of transformer insulation. In one case on a power transformer from 17,000 to 440 volts and another from 13,000 to 110 volts. In the case of accident on the 17,000 to 440 volts, two conditions were brought out; first the unreliable ground conditions that exist in the mountainous districts of Colorado, and second the menace to life due to the rule of the National Electric Code that motors operating at a potential of 550 volts or less be thoroughly insulated from the ground wherever feasible.

This, your committee believes under the operating conditions existing with a large number of the power companies of this association is a menace to the life of employes operating motors under these conditions, particularly where such motors receive their power from transformers stepping down from a relatively high potential (i. e.) potentials above 5000 volts, and would suggest that this be brought to the attention of the National Board of Fire Underwriters, as in a case of this kind the grounding of secondaries supplying power to an insulated motor would not give absolute protection.

In a large number of cases of shock sustained from the power circuits, the shock is usually received not from the circuit itself, but from the frame of the motor being supplied by the circuit. Where high potential transformers are used for lighting purposes, the neutral point of the secondary circuit together with the transformer case should be thoroughly grounded.

In conclusion, your committee would recommend that the question of grounding be brought more forcibly before the member companies in order that more definite information and a closer study and results be obtained.

The member companies of this association are probably more peculiarly situated as to the importance of the question of grounding than any other association on account of their different operating conditions, location, frequency of lightning storms, transmission and distribution of electric power and lighting over high potential circuits, and unfavorable ground resistances ances that exist in the Rocky Mountain district.
that exist in the Rocky Mountain district.

J. A. Clay, Chairman
C. F. Flower, W. A. Carter, Commitee

Analysis of telephonic speech shows the necessity for clear enunciation. All of the vowels, in compelling an open mouth and throat, give free passage for the vibration of the vocal cords, but most of the consonants, produced either with closed lips or cleaved tongue or being a mere exhalation of breath, do not actuate the vocal cords. The letters f, h, p, q, r, s and t have no distinct sound until a following vowel is sounded, being purely breath; b, c, d, k and w have practically no sound; g and j have a throaty sound, while m and n are nasal. The difficulty in distinguishing between f and s, m and n, etc., is well known.

DISCUSSION ON STEAM ENGINEERING PRACTICE.[1]

Control of Fluctuating Load.

Question: How is it possible to determine the average load on a compound or triple expansion engine where the load is very rapidly fluctuating, i. e., where this fluctuation is not only seasonal but daily, and where you find the fluctuation so rapid as to be almost intermittent as in a plant running a system that is feeding a mine hoist?

In electrical work we are meeting this condition by two methods; by running a motor-generator set consisting of a slip-ring motor driving two direct current generators on the same shaft with a heavy fly wheel; at the mine shaft direct current motors are used. In Nevada a great deal of trouble is caused by the extreme fluctuations and these have been corrected by using storage batteries which result in a continuous and uniform supply of current from the power line. I want to get some information on steam plants where the load is extremely variable.

What would you do in case you were called upon to report the load on your plant if it is seasonal and daily changing as well as intermittently fluctuating?

Answers: There is a plant near Cleveland where a power company contracted to furnish power for coal discharging. When they began to get the coal over the fluctuation was found to be too great and they put in a balancing set; a large motor with a heavy fly wheel, and with this apparatus they took a series of calculations and based their average load upon these. They connected in such a way as to strengthen the motor at the peaks and received very satisfactory results.

I would think that the machine steam meter and the indicator together taken fast enough would give a fair average value. Take for instance the street car system. A recording steam meter would be absolutely correct. I have seen one in the Monadnock Building.

The California street cable road engine allows the pressure to fall during load fluctuations. Once it fell ten pounds within a minute. The variations are so great that at times the engine is run by cars on the system. The steam meter is the only correct way to read that. With a triple expansion engine, while one meter will do, with three meters you can get almost correct results. We have tried the indicator but without avail. Once we tried to get an average of the speed and pressure and struck a pretty fair average. When the cars are running the engine you have two receivers bucking their strength against the cylinder until the steam is exhausted. The cards will show all of this.

While you get the correct steam drawn from the boiler at any instant with the steam meter is that any guarantee that you would get any correct measurement of the power being applied at the same time?

The receivers on this engine are very long, one being about twenty-seven feet. They are so long that when the engine is running along and is gradually shut off the steam is drawn from the receivers. When the load comes on again the power is at first being applied only on the high pressure cylinder. The vibration at this time is terrific. This is due to the fact that when the cars were running away with the engine the steam was drawn out of the engine and receivers and when the load returned the high pressure got all the work. In such a case the amount of the steam would be recorded by the steam meter and we could not get the correct reading otherwise.

I have heard of the chronograph to get the record of the different number of revolutions taking place in any minute. This had a pendulum making a pen mark in the paper and also had a pin to trace every revolution. When the engine slowed down the marks of the pen were all uniform but the pin punctures were further apart.

[1]California No. 3, N. A. S. E.

Some types of engines have each cylinder arranged with a separate governor. By coupling up three indicators, each one taking the average at the same time, you will get a very close result. I was out to the California street cable engine one day and was stationed at one cylinder, with two other men at the others. We had no electrical apparatus. We took off a pretty fair average this way and I think we were right. When the governors were clear up we would take a look at our different cards at those times, and we could arrive at a pretty close record of what the engine was doing under all conditions. The load on that engine runs from six hundred horsepower down to nothing. I think they run thirty-five or forty cars. In the Alaska Commercial Building they were using a tandem compound engine running the Otis traction type of elevator. The current required for that type of elevator in starting is much more than when started. At times the engine was pulling all that it could and the very next moment, as indicated by the ammeters, the load was gone entirely. A short time ago they installed a storage battery with a balancing set. The load is now almost constant on the engine with practically no change. When the elevators are stopped the engine goes right along and pumps back into the batteries. That is how they get along with the intermittent load. The ammeter varies from 600 up to 1000 and back to nothing.

This question may be answered in many ways, as the installation of steam driven light and power equipment differ radically in nearly every station under observation. The experience of the writer as an operating engineer lies chiefly with alternating current dynamos of from 2300 to 4000 volts, as regards the subject of speed regulation, with various forms of power transmission from the several types of engines.

As an illustration of how two machines may be operated harmoniously with fluctuating loads of an entirely different character, we will take for example, two 500 kw. 2300 v. alternating current dynamos. Machine No. 1 is working to full capacity in street car service (via motor generator sets) and is driven by a tandem compound Corliss engine running at 75 r.p.m. and controlled by an ordinary fly-ball governor. The transmission of power from engine to dynamo in this case is through a seven rope drive, the total length of rope in use being 2500 lineal feet.

Machine No. 2 is directly connected to the shaft of a cross compound engine having cranks at 180 degrees and is regulated by a shaft governor set to 150 r.p.m. This engine is run upon lighting circuits exclusively and loaded to a 30 per cent overload.

Now as the operating engineer finds his lighting load reaching the peak on machine No. 2 he is also aware of the drop in frequency from his standard of 60 cycles to, we will say, 58, and at the same time he notes the fluctuations of all recording instruments upon the lighting panel, which represent to him the lagging of his over loaded engine in crossing crank centers. At this point something must be done to retain the normal voltage if possible. He watches his power panel and finds a fluctuation of perhaps four cycles due to the general conditions of a street car system. Here is his hope for the restoration of his lighting circuit voltage, and he is quick to take advantage of it, the synchronizer is put into operation and as the power load on outfit No. 1 increases to the detriment of the speed, it finally drops to that of outfit No. 2 and the machine bus-bars are united as one, giving a harmonious operation throughout the hours of the overload.

The above operations show what may be done in regard to converting the light and power appliances of yesterday and today to a unity. In this case the sluggish action of the Corliss governor plus the loss of quick action of the machine due to stretch and slipping of the 2500 feet of rope kept the speed of machine No. 1 constantly fluctuating.

Machine No. 2 was overloaded and with engine cranks at 180 degrees was unable to retain normal speed passing centers.

The combination of outfits gives better results in many ways. First—When the operator put the machine into a synchronous action he caught one engine crank at an angle to the other which was of benefit to both engines. Second—Machine No. 1 was able to assist in raising the lighting load voltage at each lightening of the power load. Third—With the quick increase of the power load which formerly slowed the engine, the quick action of the lighting engine governor would rescue the falling speed of the slow running Corliss.

Coal.

Coal is an organic compound which has been subject to pressure for a long time. Its chief ingredients are hydrogen, oxygen, nitrogen, carbon, sulphur and ash.

A few of the best known lump coals are Newcastle (England), Scotch (Scotland), Wallsend (Australian), Chin-Wan-Tau (China). There is also a good steam creating coal to be had in Japan called Miki Nuts. It is very small, never more than 1¼ inches square, and seldom smaller than ½-inch square. Welsh coal has little flame and little smoke, being called smokeless. It comes from the outskirts of Cardiff, Wales.

The first named lump coals give much flame and smoke and burn much faster than Welsh coal, but do not give out such an intense heat, locally, as Welsh coal.

Corrosion of coal, a matter to which few engineers give much thought, is an important item where there is a large amount to be kept on hand. Corrosion can be seen if a piece of soft coal is taken up and broken into small pieces until a golden colored spot is seen, this spot being the result of the coal burning before being put into the furnaces.

Some time ago the British government made a test to see if they could remedy this serious matter. They made an oblong tank and put 500 tons of coal into it, this they lowered into the water in one of their docks in Portsmouth, being kept there for a year. At the same time they had 500 tons of the same coal exposed to the elements for the same length of time. Afterwards burning experiments proved that the coal which was under water had a loss of only 5 per cent while the coal which had been exposed had a loss of 25 per cent. They proved that the coal which was exposed to the attack of the air, rain, snow, etc., burned more after rain than it did before, and that the longer it was exposed the greater corrosion became. And again they proved that the coal under water stopped corroding until brought out again.

The space occupied by coal varies from 42 to 45 cubic meet per ton. The fire-bars should be spaced about ⅝ in. for Welsh coal, but the firemen should not knock it about, or it is likely to fall into the ash pits. Newcastle, Scotch, Wallsend and Chin-Wau-Tau coals can be fired economically with the fire-bars spaced at ½-in.

CHARLES MORTON.

Electric lamb forcing is reported by Professor Silas Wentworth of Los Gatos at his experimental farm on the Tyler place, near Roseville, California. It is stated that a band of 2000 sheep was divided, one-half being placed in a field under the power wires of the Great Western Power Company, while the others were kept away from electric influences. In the field under the electric power line the production of lambs averaged a fraction over two lambs to each ewe. In the adjoining field where electrical influence was lacking, the lamb average was less than one to each ewe. Similar differences were noted in the yield of wool from the sheep in the different fields. The fleeces from the sheep in the electric influenced field proved 20 per cent heavier.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

DIRECTORS

R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong

604 Mission Street, San Francisco

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
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CONTENTS

Service Extensions

The latest census returns show that the long advocated "back to the country" movement has at last started. Suburban communities are rapidly gaining in population because of the superior inducements they now afford. Paramount among these attractions are those comforts and conveniences, such as light, heat, power, water and communication, which have heretofore been found only in the cities. One of the strongest arguments of the real estate dealer is that water and gas have been piped to his property, that electric and telephone lines pass through it and that a suburban trolley line is nearby.

To provide these facilities for outlying communities is a serious problem, for the initial investment is large and the subsequent revenue from scattered consumers much less than that from those congested in the narrow confines of a large city. Public service corporations are often severely criticized and lose much popularity because they refuse such extensions free of charge. They are frequently arraigned, as by Mr. C. A. Luckenbach in his paper on "General Policy Regarding Pipe Extension" because they demand a bonus. Mr. Luckenbach's remarks, while written for gas men apply with equal force to those operating electric railroads, telephones, electric power plants and waterworks. His conclusions are founded upon the idea that a public servant must keep the good will of the public it serves.

While this is in a large measure true and should be well heeded by the companies, there is another side to this question which should be brought prominently to the attention of the public. Many a public service company is now compelled to put all its earnings into unprofitable extensions. Though in time these may also produce their share of income, there is an interminate interim during which they are operated at a loss.

We thus have two extremes, one where the extensions are made by the company regardless of future income, and the other where a certain bonus is paid by those desiring the service. These two extremes are illustrated at almost every farm house which has free rural delivery, but which is visited by the butcher only twice a week. R. F. D. on the farmer's envelope is today one of the causes of our postal deficit and yet its money cost is more than compensated by its advantages. The butcher goes only to a profitable territory and charges as he pleases. The farmer that he does not serve must drive his own team to market if he wants meat.

The public service corporation usually adopts the mean of these two extremes and devises some method by which the consumer bears at least a part of the initial investment. No odium attaches to a steamship company because it accepts a government subsidy whereby it is enabled to operate an otherwise unprofitable line. Likewise if the public were educated to see this matter in the same light, the public service corporation would not be stigmatized for requiring a reasonable amount for improvements if they were to be installed at a loss and if the company received no other compensation, such as a valuable franchise.

PERSONALS.

C. L. Cory is at Los Angeles.

A. W. Ballard of Los Angeles was at San Francisco this week.

Frank H. Ray, of New York, was at San Francisco during the past week.

A. M. Hunt returned to San Francisco during the past week from Southern California.

H. B. Woodill, an electrical supply dealer of Los Angeles was at San Francisco this week.

R. J. Russell, secretary of the Century Electric Company of St. Louis, Mo., is at San Francisco.

Henry T. Scott, president of the Pacific Telephone & Telegraph Company, left last week on a trip to New York.

J. W. White, sales engineer with the San Francisco office of the Fort Wayne Electric Works, is at Goldfield, Nev.

Frank Fowden, manager of the Brooks-Follis Electric Corporation, has returned to San Francisco from Los Angeles.

Walter Creasey has resigned as chief electrician for the Copper Queen mine of Bisbee, Arizona, and is now at Los Angeles.

E. G. Dewald, with the Pelton Water Wheel Company, has returned to the San Farncisco office after making a tour of Utah.

H. A. Sayles, of the sales department of the Holabird-Reynolds Company, has returned to San Francisco from a Northern trip.

George C. Holberton, general manager of the San Francisco Gas & Electric Company, has returned from an extensive Eastern trip.

J. H. Hornung, commercial agent of the Great Western Power Company of San Francisco, is spending a vacation in Northern California.

Thomas Mirk, of Hunt, Mirk & Company, has returned to his San Francisco office after inspecting some work in progress at San Diego.

L. H. Baldwin, assistant manager of the Pacific Coast agency of the Kellogg Switchboard & Supply Company of Chicago, is in Southern Oregon.

C. E. Sloan of Spalding, Sloan & Robson is at Madeleine, Lassen county, Cal., where a number of irrigation ditches and a large reservoir are to be constructed.

W. S. Heger, California district manager of the Allis-Chalmers Company, has returned to San Francisco after spending a few days at his Los Angeles office.

H. H. Noble, president of the Northern California Power Company, consolidated, is making an inspection of his hydroelectric system in Tehama and Shasta counties, California.

J. P. Downs, traffic superintendent of the Pacific Telephone & Telegraph Company, has returned to his San Francisco office after an inspection tour of the company's lines in the Pacific Northwest.

L. A. Richards, in charge of the car department, and S. K. Colby, vice president of Pierson, Roeding & Co., are at Atlantic City to attend the annual convention of the National Street Railway Association.

R. W. Gray has been appointed Division Plant Superintendent of the Western Union Telegraph Company's Pacific Division with headquarters at San Francisco. He was formerly in the service of the Pacific Telephone & Telegraph Company at Portland, as Division Plant Engineer.

R. S. Chapman, electrical engineer with H. M. Byllesby & Co., recently returned to the firm's Portland office from Chicago.

R. E. Thompson, general manager of the San Diego Home Telephone Co., is at San Francisco in connection with some important extensions.

Will Spalding, formerly construction engineer with the Portland Railway, Light & Power Co., has been appointed general manager of the Tillamook Electric Light & Fuel Co. at Tillamook, Oregon.

A. G. Wishon, general manager of the San Joaquin Light & Power Company, with headquarters at Fresno, arrived at San Francisco last week and spent several days in conference with prominent electrical men.

J. F. Adams, general manager of the Nevada, California & Oregon Telephone Company with headquarters at Reno, Nev., visited San Francisco during the past week. He is making preparations to install a local plant at Alturas, Cal.

O. Shortall, of the construction department of the Electric Storage Battery Company, of Philadelphia, is spending some weeks on the Pacific Coast, making his headquarters with Pierson, Roeding & Co.

William A. Newcome was recently appointed manager of the San Francisco office of the Western Union Telegraph Company. He is an old resident of the city, having lived here for fifteen years. For several years past, however, he has been in the diplomatic service of the government at Washington, D. C., and abroad. He returned lately from an extensive European tour.

TRADE NOTES.

The Tramway Safety Appliance Co. of San Francisco has equipped one of the cars of the United Railroads Company with its device for preventing platform accidents. It is now under test.

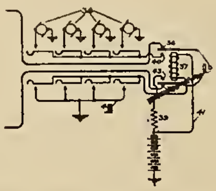
The Pomona Valley Telephone & Telegraph Union has awarded a contract to the Kellogg Switchboard & Supply Co. for a complete multiple, harmonic switchboard, together with auxiliary equipment for use at Lordsburg, California.

The General Electric Company is building for the Long Beach, Cal., steam station of the Southern California Edison Company, a large switchboard to control one 15,000 k.v.a. 11,000 v. turbo-generator, three 2000 kw., 11,000 v. local feeders, two 11,000, 35,000 to 70,000 v., 6000 kw. step-up transformers, two 35,000 v. and two 70,000 v. outgoing lines. The switchboard will consist of instrument and controlling bench-board, vertical exciter and auxiliary panels, together with complete equipment consisting of DH and HE instruments, DS-5 watthour meters, motor operated H-3 and solenoid operated K-12 oil break switches, 11,000 v. graded shunt and 35,000 and 70,000 v. aluminum cell lightning arresters.

The General Electric Company reports the sale of two additional 4000 kw. generators to the San Joaquin Light & Power Company. The generators and auxiliary apparatus, it is understood, will be installed in the North Fork hydroelectric station, about 40 miles from Fresno, where two similar units have been in operation several months. The apparatus sold is rated as follows: Two A. T. B. 18, 4000 kw. 400 r.p.m., 2300 v., water-wheel driven generators. Also, one motor-generator exciter set; M. P. 6, 100 kw., 900 r. p.m., 250 v. shunt-wound generator, direct connected to one I. 8, 150 h.p., 2500 v., induction motor, also arranged for direct connection to a water wheel. Also seven W. C. 60 cycle, 1500 kw., 20,050 v., 169,500 v, y—2300 v, transformers, complete with switchboard equipment. Doble water wheels will be direct connected to the new generators. J. G. White & Co. have charge of installing all of this new apparatus.

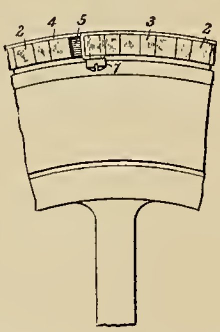
PATENTS

971,650. Four-Party-Line Ringing-Key. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. In a telephone system, the combination with a telephone line, of a plurality of substations on said line, each having an annunciator, of a cord circuit adapted to be connected to said line, a plurality of selective ringing contacts associated with said cord circuit each adapted to



selectively signal one of said line annunciators, a path for voice currents around said contacts, and an electro-magnetic device having its circuit completed through said contacts, said device being adapted to be energized by the actuation of the ringing key to connect said contacts with the talking circuit when any one of said contacts is operated to call a subscriber, the restoration of said device being under the control of said ringing key, substantially as described.

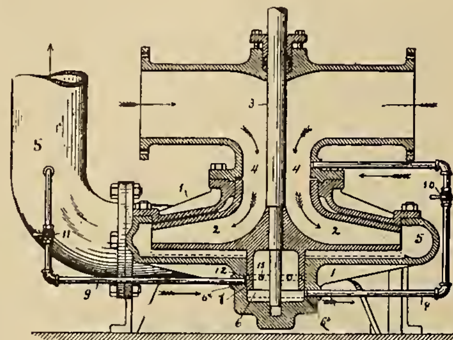
971,649. Inductor-Motor. John E. Webster, Pittsburg, Pa., assignor, by mesne assignments, to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. In a dynamo-electric machine, the combination with a core member, and



conducting bars extending through and beyond its ends, of conducting blocks between the projecting ends of the bars, a plurality of convolutions of wire surrounding the blocks and the ends of the bars, and means for securing the ends of the wire to one of the bars.

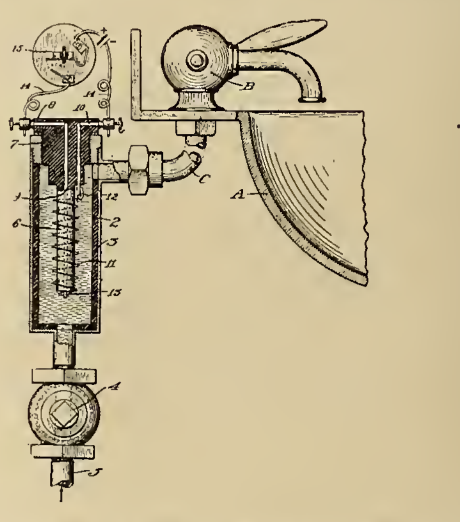
971,767. Thermo-Electric Couple. Albert L. Marsh, Detroit, Mich., assignor to Hoskins Manufacturing Company, Detroit, Mich. In a thermo-electric couple, a positive element formed of an alloy containing a relatively small proportion of aluminum and a metal having the properties of nickel, in such alloy, of obtaining in cooperation with a nickel-chromium negative element, high electromotive force, a high melting point and a comparatively straight line electromotive force-temperature curve, an electro-positive element formed of an alloy containing nickel and approximately 2 per cent of aluminum.

971,852. Centrifugal Pump. Ferdinand W. Krogh, San Francisco, Cal. A self balancing centrifugal pump comprising a casing having a suction inlet and a pressure outlet, a ported pressure chamber, pipes respectively connecting the ports of the chamber with the inlet and outlet, and an impeller wheel arranged within the casing directly above the



chamber and provided with a depending hollow plunger adapted in one position to close the port of the chamber connecting the inlet, said plunger being provided with a passage which is adapted, in another position of the plunger, to communicate directly between the other port of the chamber and the interior of the plunger.

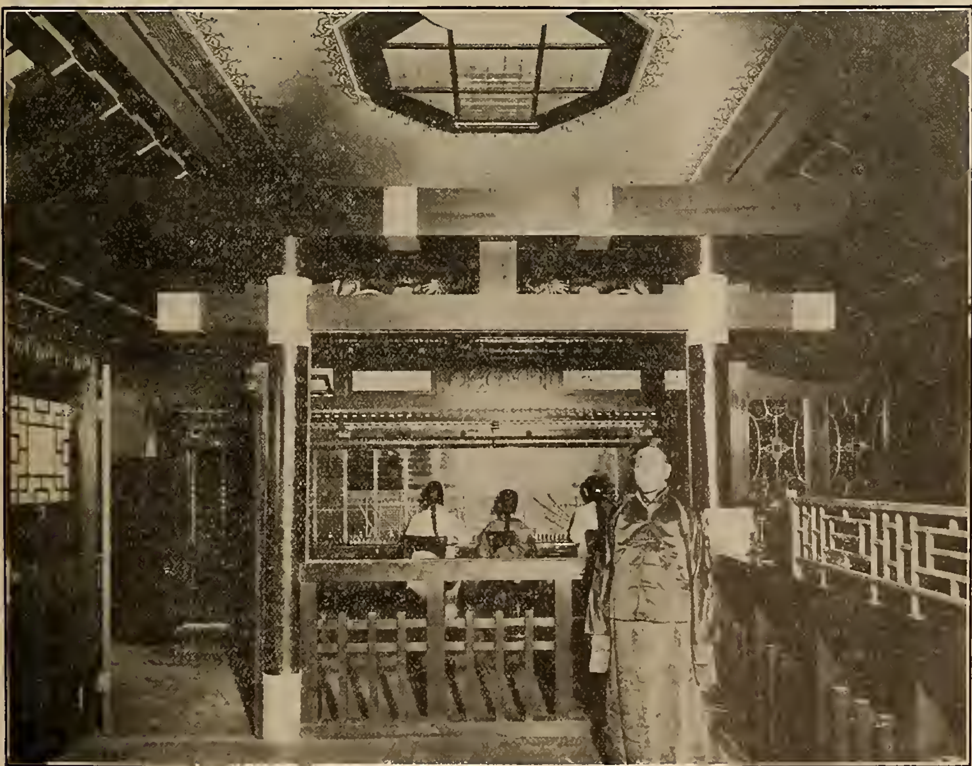
972,131. Electrical Heater. Milton H. Shoenberg and George T. Marsh, San Francisco, Cal., assignors to Appliance and Electric Device Company. The combination with a supply pipe and a controlling cock, of a casing having axially alined openings at opposite ends, a non-conducting lining within the casing, said casing having its upper end internally threaded and having an extension from the lower end adapted to connect with said supply pipe, non-conducting



tube within the casing having an enlarged head externally threaded to engage the internal threads on the casing, said tube having the portion below the head of reduced diameter, and terminating above the lower end of said casing, a resistant conducting coil surrounding the reduced body of the tube, an electrical conductor projecting from the lower end of the tube and connected with one end of the coil, a second conductor passing through the head and connected with the upper end of the coil, and binding posts upon the opposite sides of the head exterior to the casing, with which posts the conductors are connected.

INDUSTRIAL

Exterior of Chinatown Telephone Office



Manager of Chinatown Exchange in his Oriental Costume

SAN FRANCISCO'S UNIQUE TELEPHONE EXCHANGE.

San Francisco's telephone system contains an exchange which is not like any other telephone office to be found anywhere. In its appearance, the personnel of its operating force and the character of the service it gives, the Chinatown "central" is unique. This exchange is further interesting as a part of the telephone facilities of one of the best telephoned cities in the world.

The Chinatown telephone building is strikingly Oriental in its exterior and interior details. The plans were worked out by the telephone company, with the aid of a prominent Chinese merchant. The structure has three pagodas, giving it the appearance of the residence of some important Chinaman, for in China the number of roofs on the house indicates the rank of its occupant. The woodwork in the interior of this building is rough-cut material, finished in ebony.

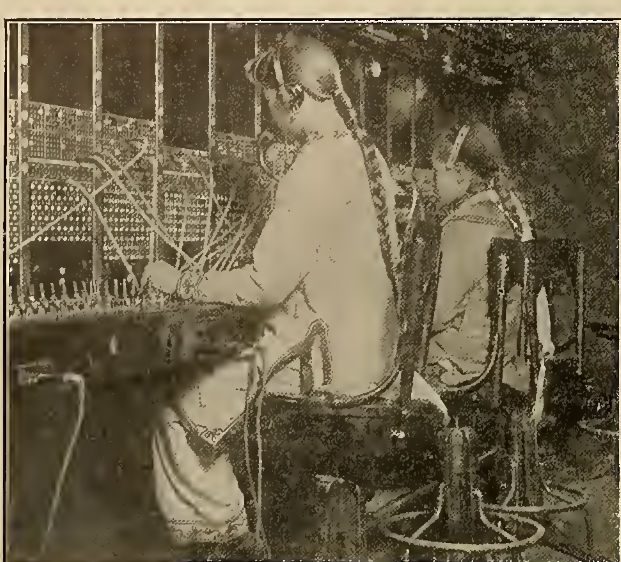
This exchange is one of nine operated by the Pacific Telephone and Telegraph Company in San Francisco and is on Washington street in the heart of Chinatown, a few blocks from the Bush-street central office. With the exception of the sign outside the front door and the fine new multiple switchboard within, everything about this building is truly Chinese. The manager of the exchange is a Chinaman, so is the chief operator, and the switchboard operators are Chinese boys and girls.

The manager, Loo Kum Shu, is an American-born Chinaman, and has been associated with the branch of the Bell Company in San Francisco for about ten years. Mr. Loo has complete charge over the 3500-line board and his little operating staff. The chief operator's name is Ah Sing. Like the manager, Ah Sing speaks good English, and so do the three little girl operators, whose names are Ah Mee, Ah Bow and Ah Soo. The other three operators are Chinese boys. These young people have been recruited from the mission school in Chinatown, and they are said to make excellent operators.

Some little time ago, when Chinese telephone commissioners were in this country investigating telephone plants for their home government, they were shown this Chinatown exchange and were

much impressed by the work of the Chinese operators. It was demonstrated to them that an American switchboard can very conveniently be adapted to the uses of the Chinese, and this is believed to have been one of the reasons why they selected for the first exchange of the new Peking system an equipment from the same shops at Hawthorne.

The switchboard at present in the Chinatown exchange is a comparatively new one, having been installed since the big fire of 1906 in San Francisco, which completely destroyed the telephone building and equipment then in use. It is now taking care of 800 subscribers' lines. The board is a Western Electric Number One, a central battery equipment of the most up-to-date type.



Chinese Girl Operators in San Francisco

This exchange handles only calls for stations in Chinatown. Whenever a call from an outside station destined for other points comes in the operator switches it over to the Bush-street exchange.

The girl operators know the names of nearly all the Chinatown subscribers and are able to switch the calls about without resorting to the directory. As a matter of fact, the Chinese part of the San Francisco telephone directory is not arranged by numbers, but by names of streets, and a caller for a station in Chinatown gives the name of the firm or individual he wishes to reach.

In the basement of the building containing the cable rack and all the other apparatus other than the switchboard, the usual standard construction of the Pacific Telephone and Telegraph Company is carried out. The energy for this exchange is obtained from 11-cells, Type E-11, "Chloride Accumulator," manufactured by the Electric Storage Battery Company. The battery is charged by means of a 30-ampere mercury arc rectifier.

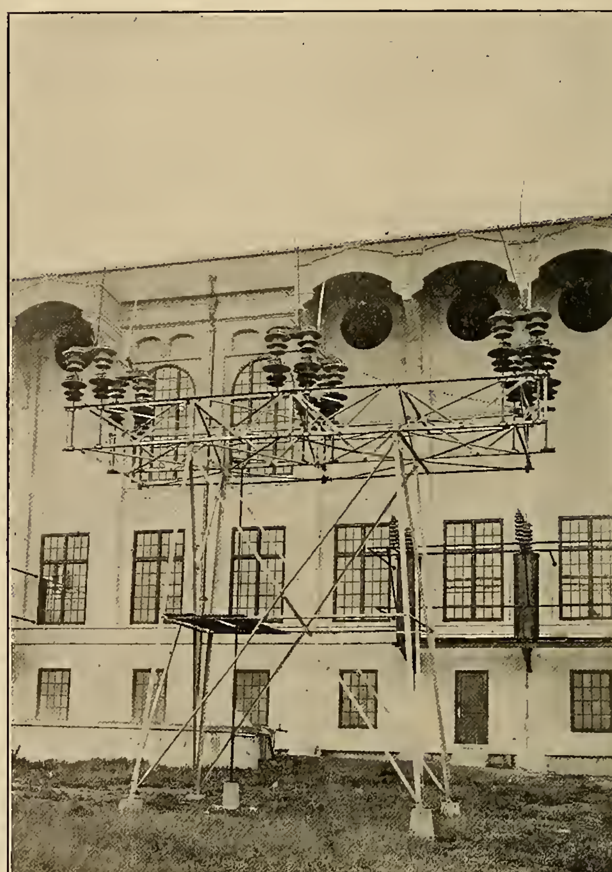
TEST OF 104,000-VOLT KILARC SWITCH.

At the Bay Shore substation of the Sierra and San Francisco Power Company is installed a Kilarc open air switch, built by the Bowie Switch Company, through which passes one of the incoming lines from the Stanislaus Power Company. The system is operated at 104,000 volts—the highest pressure at present in commercial use. This switch was built for operating under load, to handle at least 10,000 kw. It is of special design, but the operating parts for breaking the load are similar in principle to those of the standard type K switch built by the same company. By the direction of motion of the blade, the arc is first drawn upwards, away from the insulators, thereby avoiding any possibility of the heat of the arc affecting the insulators.

This switch, which has been in service for the past three months, is situated in a location particularly severe on insulators, owing to the salt fogs, high winds and dust. Furthermore, the insulators have not been cleaned since it was installed.

To determine the ability of the switch to open under load, a test was recently made by loading the lines with an inductive load of 52 amperes on the high-tension side, or over 9000 kilovolt amperes. The switch handled the load without the slightest difficulty, and opened without causing any voltage disturbance to the system, other than would occur from the change of current. There was practically no surge on the line, and the pressure at the power-house raised only 3500 volts, or about 3 per cent maximum when the switch was opened. This was conclusive demonstration that no material voltage rise accompanies the opening of horn switches of proper design.

This is a subject which has caused considerable discussion



The Bowie Disconnecting Switch

by engineers, as some have maintained that the opening of air switches would set up serious oscillations in the line. Air switches of improper design are liable to cause trouble, but the results of experience have shown that well-designed horn type switches will operate without causing material disturbance of voltage.

This test was particularly severe owing to the highly inductive load which tended strongly to maintain the arc, and to have the stored magnetic energy kick back on the line. Judging from the manner in which the switch operated, its actual capacity is far in excess of the rating. The photograph shows a view of the switch, which is mounted on a structural steel framework, thoroughly braced.

The Kellogg Switchboard & Supply Company of Chicago has closed a contract for a toll-board for the Home Telephone Co. of Spokane, Wash.—the company controlled by the Lane syndicate. It is a nine-position toll-board, complete with desks and testing equipment.

SINGLE-PHASE TRACTION IN FRANCE.

The electrification of existing steam railways is being pursued with activity in France. One of the latest electrifications is that which the Midi Railway of France will make in connection with the Montrejeau-Pau portion of the Toulouse-Bayonne Line. The portion to be electrified has a length of some 70 miles; the country is very hilly and the line has a number of gradients, one of 3½ per cent being about seven miles in length. This is the largest scale upon which electrification of existing lines has been attempted in France, and the results will be watched throughout Europe with no little interest. Later the electrification is to be extended to the entire Toulouse-Bayonne Line, a distance of 200 miles.

The Midi Railway Company has ordered from the French Westinghouse Company, whose works are at Havre, the equipments for 30 double bogie electric motor coaches for the passenger service and one complete electric locomotive for the freight service of this line. The locomotive and motor car equipments will be built entirely at the Havre works of the French Westinghouse Company, while the mechanical part of the locomotive will be built by the Italian Westinghouse works. The design and construction is based on the results obtained in connection with the very successful electrification by the Italian Westinghouse Company of the Giovi tunnel section of the Italian State Railways on the dense traffic line between Genoa and Milan.

Each of the 30 motor coaches, each seating about 50 passengers, will be equipped with four 125 h.p. Westinghouse single-phase motors, 16 2-3 cycles, 285 volts, and with Westinghouse multiple control. These motor coaches will be able to haul trains weighing 100 metric tons—including the motor itself—at a speed of 45 miles per hour on level track. The weight of a motor coach in running order will be about 56 metric tons.

The Midi locomotive will be provided with five axles, three of which will be driven by the motors through jack shafts and connecting rods. The locomotive will be equipped with two 600 h.p. single-phase motors. The locomotive will weigh 80 metric tons and will be able to haul trains weighing 400 metric tons, inclusive of the locomotive. With a haulage load of 280 metric tons the speed will be 25 miles per hour, and with 100 metric tons about 38 miles per hour.

The current will be supplied to the motors by means of a 12,000 volt overhead catenary line. The pantagraph type of trolley will be used.

NEW KELLOGG CONTRACT.

The Kellogg Switchboard and Supply Co. announces that it has closed a contract for complete switchboard equipment for the Raleigh Tel. Co., Raleigh, N. C. There is to be a new standard type switchboard consisting of two sections, each having a capacity of 3000 multiple jacks. The two sections are equipped with 700 common battery lines installed in five regular positions, with full multiple installed every four panels and twenty magneto lines installed in the first position next to the box panel.

Each of the regular positions is equipped with fifteen common battery cord circuits, each pair of cords having an individual four-party ringing key. The farmer's position is equipped with ten combination toll to toll and toll to local cord circuits.

The Kellogg Company also furnishes the necessary main distributing frame and relay rack. The telephone company will use the present power equipment.

This switchboard has some special patented operating features in it which were furnished at the special request of the manager, Mr. W. A. Wynne. The system is so wired that when any subscriber removes his receiver from the hook, he will be immediately connected with the operator, who will receive the request for the subscriber desired and plug in with the calling cord and ring the desired party before inserting the answering plug, thus giving quicker service. If, however, another call should come in before she completes the first call, the operator can prevent the second calling party from interfering by plugging into the answering jack with the answering cord in the usual manner.

A subscriber often desires to call several parties in rotation and the cord circuits have a special feature for this arrangement that after conversation has been completed all the calling party has to do to again be able to speak directly to the operator is to operate his switch hook once. He will then be able to tell the operator what party he desires next and this without the operator having to throw her listening key.

This arrangement has already been used in this system for several years with great satisfaction to the subscribers.

While the Kellogg Company emphasizes the importance of standard equipment, they are anxious to co-operate with customers in the installing of equipment especially suited to individual needs and offer unequaled experience and factory facilities for the building and installing of special service equipment.

NEW CATALOGUES.

Bulletin No. 9635, describing Hawthorn Commercial and Folding Type Mazdaliers, has been issued by the Western Electric Company.

Bulletin No. 4767, just issued by the General Electric Company, illustrates and describes motors designed particularly for use in steel mills.

Bulletin No. 234 from the Sprague Electric Company illustrates and describes portable electric breast drills designed for either direct or alternating current.

The General Electric Company has recently issued an attractive bulletin, No. 4755, illustrating and describing the electrical equipment of the Great Northern Railway.

Paragon Bulletin No. 1 from the Paragon Sellers Co., 63 Fifth avenue, Chicago, illustrates and describes the Paragon ground cone which is intended as a protector against high potential static discharges.

A new bulletin on the isolated plant direct current combination generator and feeder panels, No. 4763, which supersedes previous bulletins on that subject, has just been issued by the General Electric Company.

Charles C. Moore & Co., San Francisco Pacific Coast managers for the Babcock & Wilcox Co., are distributing the 1910 catalogues of Sterling Boilers. This 21 page book is attractively illustrated in colors and bound in board covers 8x10.

The Western Electric Company has issued booklet T-206, describing its composite telephone and telegraph system for railway service. This system has been devised for the purpose of enabling telephone and telegraph messages to be transmitted simultaneously over grounded telegraph lines.

Bulletin No. 4749 on alternating current switchboard panels has been issued by the General Electric Company, and will prove of interest and great assistance to any one considering purchase of switchboard panels. The panels illustrated in this bulletin are of the sectionalized type, and each section has a separate catalogue number. These panels are in three sections, and the pages of the bulletin are sectionalized so that the user may have before him a picture of the complete panel desired, together with a full description of the equipment.

NEWS NOTES

INCORPORATIONS.

MT. VERNON, WASH.—The Home Water Power Company, capital $50,000, has been incorporated by J. E. Perrin, D. E. Henderson and Thos. Smith.

EL CENTRE, CAL.—The Imperial Valley Electric Company has been incorporated by J. W. Finch and C. F. Ferguson, with a capital stock of $10,000.

ONTARIO, CAL.—The Manzanar Water Company has been incorporated by G. A. Hanson, Isaac Baxter and C. E. Sears with a capital stock of $250,000.

MONTEREY, CAL.—The Mission Home Telephone Company has been incorporated by Thos. J. Field, Arthur G. Metz, E. Cook Smith, Carmel Martin and Geo. S. Gould, Jr.

SAN ANREAS, CAL.—The Patent Electric Fuse Spitter Company has been incorporated by Frank Bernardino, J. B. Sause, T. C. Peters and F. M. Sorracco of Sutter Creek, with a capital stock of $200,000.

STOCKTON, CAL.—Articles of incorporation of the Tidewater and Southern Railroad Company have been filed here. The road is to be electric and the capital stock is placed at $1,000,000. While the exact route of the proposed road has not been made public, it will be built directly from Stockton to Modesto and thence to Turlock, tapping a rich section. At Atlanta, in the southeastern part of the county, a branch line will be constructed to Ripon for a feeder. The board of directors given in the papers filed by Attorney A. L. Levinsky are as follows: John A. Mehling, J. A. Coley, K. C. Brueck, George E. Minges, George F. Schuled, Byron A. Bearce and T. J. Wisecarver.

FINANCIAL.

SEATTLE, WASH.—A $1,400,000 bond issue will be submitted November 8th for the extending and enlarging of the city light plant.

CORNING, CAL.—By a vote of 163 to 23 the bond issue has been voted providing for the raising of $70,000 for a water and sewer system.

SACRAMENTO, CAL.—An ordinance has been passed calling an election for November 17th to vote on bonding this city for $666,000 for a municipal filtration plant.

LOS ANGELES, CAL.—The friendly suits brought by a local taxpayer to test the legality of the $6,500,000 harbor and power bond issues recently voted by the city has been decided in favor of the city.

SAN FRANCISCO, CAL.—The Union Trust Company of San Francisco, as trustee, invites written offers up to 11 a. m. October 22, for the sale to it of the Humboldt Transit Company's first mortgage 5s for redemption to the extent of money now in the sinking fund—$4220.

TRANSMISSION.

VANCOUVER, B. C.—C. H. Cahan, president of the Western Canada Power Company, owners of the Stave Lake plant, states that by January 1st the plant will be able to supply 30,000 horsepower.

REDDING, CAL.—Work is progressing rapidly upon the Coleman plant of the Northern California Power Company, on Battle Creek, 12 miles from the Sacramento river. The steel frame and much of the machinery is on the ground. This plant is being constructed in accordance with the designs by Rudolph W. Van Norden of San Francisco who is acting as consulting engineer for the company.

GEORGETOWN, CAL.—The Rubicon Water & Power Company has a large force of men in the field rushing the preliminary work for its large electric power plant on the American River above Georgetown.

GLENWOOD SPRINGS, COLO.—The Glenwood Light & Power Company are adding a 200 kw. General Electric water driven generator to their plant. It is hoped that with this addition they will be able to use the steam unit merely as a reserve.

SANTA FE, N. M.—An application has been made by Homer W. Schofield of Alamagordo, N.M., for waters of Tularosa creek in Otero county, to be diverted through the Tecolote ditch to a reservoir for power and irrigation purposes at a cost of $15,000.

OROVILLE, CAL.—With the settlement of the suit brought by the Great Western Power Company against the various Maack estates in this county, the power company has practically completed its rights of way for its second tower line of high tension wires from this city to Oakland. The company has been quietly engaged for the past year in buying rights of way for its double tower line.

PUEBLO, COLO.—The Pueblo Traction Light & Power Company are adding new equipment to their steam power plant, including two 1000 h.p. Sterling boilers, with patent stoking devices, and one condenser, one 1500 kw. Allis-Chalmers horizontal type turbine. The boilers are already installed and they expect to have the condenser and turbine installed in about six months. The company are making their own installations.

LAKEVIEW, ORE.—The Southern Oregon Water Power Company has made final arrangements to install a plant on Deep Creek, three miles from Adel, to generate 10,000 horsepower to be transmitted to Goose Lake, Chewaucan, Warner and Catlow valleys, and to be used for power and light in Lakeview and other towns. Engineer Charles McIntyre of Spokane will begin actual construction not later than June 1, 1911.

GEORGETOWN, CAL.—The Loon Lake Water and Power Company, successors to the old California Water & Mining Company, which has operated the water system on the Georgetown Divide for the last 40 years, is making extensive preparations for the building of large storage reservoirs and the erecting of hydro-electric power plants on this divide. The company has two offices in Georgetown, but the main work is being done about 25 miles east of here.

CANON CITY, COLO.—The Colorado Light & Power Company of Canon City have added a 1500 kw. Allis-Chalmers horizontal type steam turbine to their plant. It will utilize the exhaust steam from the two Corliss steam engines and thus the capacity of the plant will be doubled without adding more boilers. A. C. Ree of the Allis-Chalmers Company has made the installation. It was put in operation on September 28, 1910. A. C. Wallace is general manager of the plant.

MODESTO, CAL.—The Sierra and San Francisco Power Company, through its agent, W. L. McKinley, has spent the greater part of a week in South San Joaquin and Stanislaus counties securing rights of way from the main power line on the J. F. Miller land near Atlanta, south through Ripon, Salida and toward this city. It is the plan of the company to reduce from 100,000 to 15,000 volts and carry the power southward on a pole line. The line will be built immediately on the securing of the complete right of way. There will be a line from the substation westward to the town of Menteca.

PETALUMA, CAL.—The Petaluma Power & Water Company has resumed work on the enlargement of its storage reservoir on the Lawler ranch on Sonoma mountains east of this city, on which the company has already spent many thousands of dollars. The big dam is to be raised and the bottom of the lake, lowered, thereby greatly increasing the capacity of the reservoir. This makes the third consecutive year in which work on the enlargement of the reservoir has been carried on. The contract with an Oakland firm calls for the excavation of 25,000 cubic yards of dirt.

TOWNSEND, WASH.—From present indications the Elworth river in Clallam county will soon furnish electric power for manufactories in both Clallam and Jefferson counties. It is the intention of the company to transmit electric power to all points in Clallam and Jefferson counties. Mr. Aldwell, who is the leading spirit in the enterprise, is now signing contracts to supply power in the section and has signed contracts with the Western Steel Corporation to furnish their steel plant at Irondale with electric power sufficient to operate all of its machinery and the additional machinery the company contemplates installing in the near future. The company will soon commence the construction of their power plant.

OAKLAND, CAL.—Work has been started on the construction of a new subsidiary power plant in the West Oakland yards of the Southern Pacific Company for use in connection with the company's project of electricizing its Oakland and Alameda local lines. The new structure is being erected at the point where the Oakland mole lines join the inlet to the yards, and will be used as a step-down station for the high-power tension wires from the Fruitvale powerhouse. The new plant is 90 feet in length, and 60 feet in width. When completed, and equipped with machinery, which is to be of the most modern type, it will have cost approximately $100,000. The plant will be completed in March or April of next year.

TRANSPORTATION.

PORTLAND, ORE.—Work is be started on the Mt. Hood railroad from Gresham to Bull Run at once. Material is being assembled.

SEATTLE, WASH.—The injunction presented by the Puget Mill Company as against the electrification of the Madison line will be denied by the court, and work of electrifying will probably proceed.

SEATTLE, WASH.—J. B. Murphy, president of the Seattle Tacoma Short Line Company, has announced that a contract has been let for clearing the right of way between Youngstown and Buren Lake. The line between Seattle and Tacoma is expected to be in operation in two years.

EL PASO, TEXAS.—Golosk Hill and Franklin Hutts, who have asked for an extension of the Arizona street car line service, will not get the service, the Council, accepting the report of the street and grade committees, denying the petition.

DENVER, COLO.—The Denver City Tramway Company, John Evans, chief engineer, is said to be planning to enter the interurban field, acquiring the Denver, Greeley & Northwestern R. R., which has been inert for several years, and when the line is completed it will probably be extended to Boulder.

OAKLAND, CAL.—Within four months all street cars in Oakland will be equipped with fenders in accordance with the fender ordinance which was given its final passage at the meeting of the City Council last week. The ordinance will go into effect in 30 days, and the Oakland Traction Company is given 90 days after that date to meet with the requirements.

STOCKTON, CAL.—The Central California Traction Company and the American River Electric Company have just entered into a contract with the Stockton Investment Company, the owners of the new hotel building, whereby the firms have secured a long lease of the western corner of the structure.

SAN RAFAEL, CAL.—The City Trustees have passed an ordinance asking for bids for a street railway franchise in this city. Bids will be received up to the 20th of November. The franchise is liberal in its terms, and provides for a road of great scenic beauty, touching a growing territory of over 14,000 people.

SALEM, ORE.—Uppn the promise of the Oregon Electric Railway Company to build a board walk and install electric lights connecting its depot with that of the Southern Pacific Company at Tualatin, the railroad commission has withdrawn its order made a week or so ago, declaring that the Oregon Electric and Southern Pacific Company should be compelled to build a union depot at Tualatin.

STOCKTON, CAL.—The San Joaquin Valley Electric Railway Company, commonly known as the Brackett road, now has ten miles of roadbed completed. One mile north of Manteca, at the J. Walter Graves ranch, the construction camp has been located. This winter track laying will begin. Morris L. Brackett announces that within seven months the entire line will be completed from Stockton to Modesto and cars will be in operation. The new line will be operated by a third-rail system.

MEXICO CITY, MEXICO.—A concession has been granted the Mexico Tramways Company to construct an electric railway between Santa Fe, a suburb of this city, and Toluca, in the State of Mexico. The line will be 32 miles long. For a period of five years the company will have the free importation of materials which will enter into the construction. The concession provides that the main offices of the company shall be in Mexico City. The passenger tariff provides charges as follows: First class, 3 cents gold; second class, 2¼ cents; third class, 1½ cents per kilometer, with the minimum charge of 5 cents.

DENVER, COLO.—The Automatic Transportation Company of Buffalo, N. Y., is reported to have completed arrangements to build an elevated automatic railroad in Summit county, Colorado. The road is to cost $200,000 and it will be used to transport ores in the mountain districts and will be operated by electricity. The road will be built on steel trusses elevated above the snow line on piers, and will resemble the elevated system of large eastern cities. The road will be twelve miles long and will run from Keystone to Montezuma and Argentine. It will connect with the Colorado & Southern for Denver and Leadville at Keystone and with an extension of the Argentine Central at the east end. The company proposes to have it completed and ready for operation early next spring.

LOS ANGELES, CAL. — Six hundred men are now employed by the Los Angeles-Pacific Railroad Company in relaying and repaving the tracks on Sunset boulevard, beginning a series of improvements in the road which will involve the expenditure of $500,000. Fifty modern high-power interurban cars will be installed on the line, beginning a ten-minute service to Hollywood, on which commutation tickets will be sold at 5 cents a trip. These improvements, for which the contracts have already been let, are announced by Paul Shoup, director of all electric properties of the Southern Pacific Company on the Pacific Coast. Contracts have already been let for the reconstruction of the entire Sunset boulevard line. This means that the company is to expend $500,000 in reorganizing its service. The old rails will be replaced with heavy steel rails of superior quality. The roadbed will be altered and strengthened and the entire line repaved. Steel for the rails has already been shipped. .

ILLUMINATION.

LIBBY, MONT.—This place is to spend $100,000 for waterworks, electric lights and telephones.

SEATTLE, WASH.—A contract has been let to the Novelty Incandescent Lamp Company for $60,000 worth of incandescent lamps for the city lighting department.

SAN JOSE, CAL.—A petition has been presented by the Pacific Gas & Electric Company asking permission to install steel towers with concrete base along Guadalupe creek.

TRINIDAD, WASH.—The Entiat Power Company proposes to bring power here to furnish light and power for the irrigation plants on the river. The line will be extended to Ephrata.

ALBANY, ORE.—P. G. Roe, an Eastern man, has presented to the Council the matter of a gas franchise in Albany and a special meeting of the Council will be held to consider an ordinance.

BENSON, ARIZ.—J. E. Collins of Tucson, representing an independent company, states that Benson will be lighted by electricity within 60 days. A 60 kilowatt machine will be installed and two engines.

SPOKANE, WASH.—The Spokane Falls Gas & Light Company will lay mains and make other improvements to the service. The Cannon Hill district is to be supplied. The cost is estimated at about $3500.

FARMINGTON, N. M.—The electric light plant has been purchased by R. W. Kowles and associates. They have signed a contract for the enlargement and use of the Star ditch and will spend about $100,000 in improvements.

UPLAND, CAL.—An ordinance has been adopted granting to the Pacific Light & Power Corporation a franchise for 50 years to erect poles and string wires for the transmission of electricity along the easterly side of Orange Grove avenue.

SANTA BARBARA, CAL.—The Santa Barbara Gas & Electric Company has started work for a high tension 10,000 volt line from the power station on Castillo street to the substation in Montecito, which will cost $10,000. As soon as a site for a substation is decided a concrete station house will be built.

LOS ANGELES, CAL.—A great stride for developing the San Joaquin Valley has been taken by the San Joaquin Light and Power Corporation, of which W. G. Kerckhoff is president, by the completion of a trust deed and mortgages for $25,000,000 with the Trust Company of America, a New York concern, which will retire outstanding bonds of the company and furnish funds for developing of Mariposa, Merced, Fresno, Madera, Tulare, Kern and Kings counties. After the retirement of old issue, there will be issued at once $1,500,000 6 per cent bonds for the completion of the San Joaquin power plant and for finishing the Bakersfield steam plant. A system of high tension lines will also be run.

TELEPHONE AND TELEGRAPH.

GRANDVIEW, WASH.—Benton Independent Telephone Company has started improvements here.

SUMPTER, ORE.—C. E. Porter, district manager of the Pacific Telephone & Telegraph Company, will shortly start the building of a phone line from Austin to Canyon City.

LEWISTON, IDAHO.—The Interstate Telephone Company has submitted a proposal to the Commercial Club to extend its line to Lewiston from a point in Spokane county near Spokane, the project to cost about $100,000.

VANCOUVER, B. C.—The Dominion Government has given orders for the construction of a government telegraph line between Prince Rupert and Stewart, B. C. Superintendent Phelan shortly goes north to direct actual stringing of wire.

WATERWORKS.

MEDFORD, ORE.—The Council has voted to ask for bids for the construction of the city's water system, for which $30,000 bonds were voted last spring.

VENTURA, CAL.—Work has commenced on the underground water system to supply Ventura with water by the Ventura Power Company. A great dam is under construction.

BEND, WASH.—A franchise has been granted John Steidl and Thomas Sweet for furnishing water for domestic and irrigating purposes in the unincorporated towns of Lytle and Riverside counties.

JACKSONVILLE, ORE.—The Council has approved the approved the water system plans of Engineer Osgood and ordered the recorder to advertise for bids for construction. The bidder is to furnish all material and labor.

HUNTERS, WASH.—M. W. Thompson has secured a water right on the upper Hunters Falls and has leased a power site from J. B. Cameron. Mr. Thompson recently purchased the light plant here and will transfer it to the falls.

NORTH BEND, WASH.—The Council has passed an ordinance providing for the securing of necessary property for the right of way and site for a pipe line and reservoir to furnish the town with adequate water supply. A franchise for such system has been granted H. Rief.

PROSSER, WASH.—The Department of the Interior, U. S. Reclamation Service, Washington, D. C., Frank Pierce, acting secretary, will receive bids until 2 p. m., November 1, for the construction of canals, wood stave pipe and other structures in the vicinity of Prosser, Wash.

SPOKANE, WASH.—Plans for a new pumping station at the Lincoln Heights reservoir, to take the place of the present Grand Avenue and Fourteenth Avenue pumping station, are being prepared by the water department. The estimated cost of the new plant is about $8000. A 3,000,000 gallon centrifugal pump will be put in at the new plant.

TURLOCK, CAL.—Bids will be received until 11 a. m. October 24, by the board of directors of the Turlock Irrigation District, at the office of the board at Turlock, Cal., for the construction of that portion of the canal and works of said district including one diverting gate, four drops and about four miles of canal in earth on the lower extension of Lateral No. 3 of the Turlock Irrigation District, all of which is more definitely described in the special specifications on file in the office of the board of directors in the city of Turlock, Cal.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded to Foster & Vogt the contract for hauling and laying the pipe for that district of the auxiliary water supply system bounded by Van Ness avenue, Market and Powell streets, and the bay, the accepted bid being $102,809. The contract for the construction of the Peabody school went to McSheehy Bros., who had offered to do the work for $51,800. All the bids submitted on a former occasion had been rejected as too high, the lowest then received being $1300 above that now accepted from the McSheehys.

OAKLAND, CAL.—The Bay Cities Water Company will commence work at once on its $5,000,000 distribution system for Oakland, Alameda and Berkeley. A large force of men will be put to work in Melrose putting down 12, 10, 8 and 6-inch fire mains and 4-inch domestic supply pipes. The system will consist of a 6-inch main on Forty-seventh avenue and a cross system of 4-inch pipe running west from Forty-seventh avenue to High street, where all mains will be connected with a 12-inch main running along High street. The rest of the supply and domestic mains will be of 4, 6 and 8-inch pipe with no dead ends and with a full supply of water at all times.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 17 SAN FRANCISCO, OCTOBER 22, 1910 PER COPY, 10 CENTS

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

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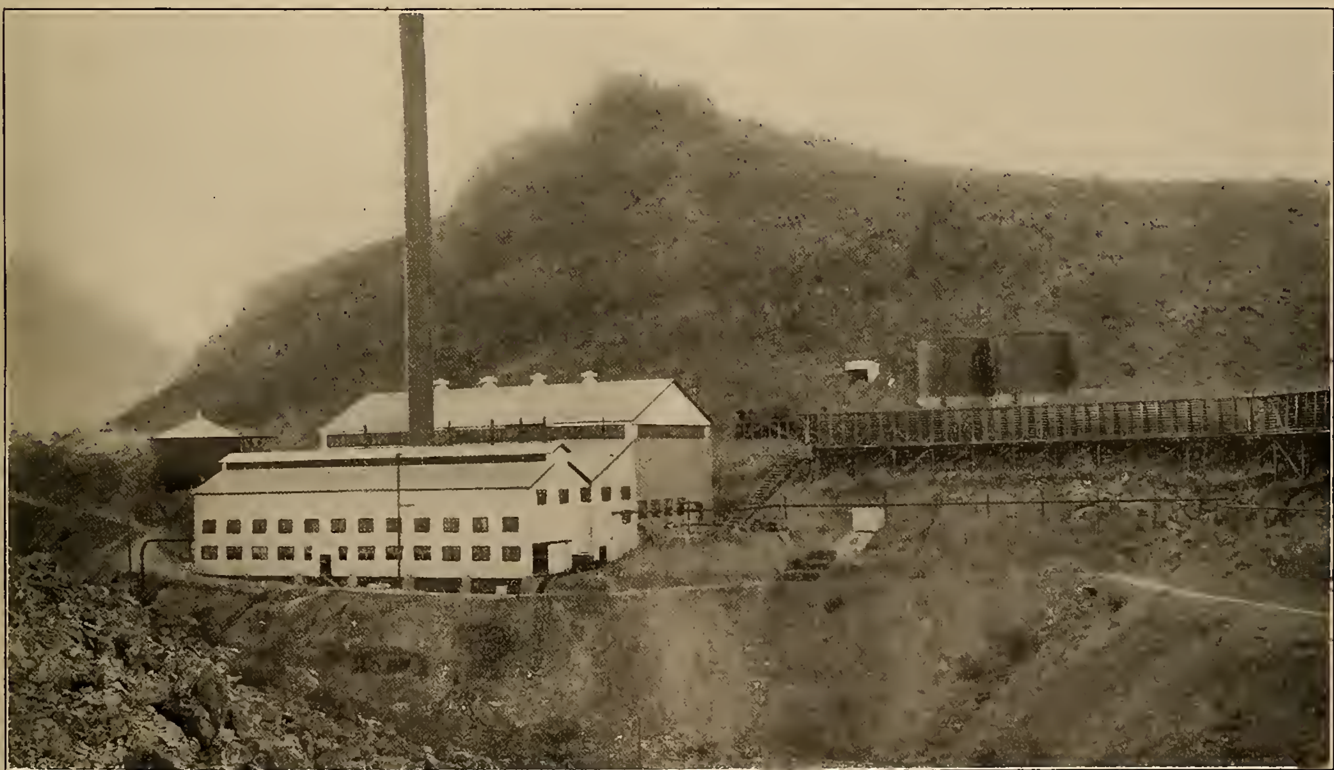
VOLUME XXV | SAN FRANCISCO, OCTOBER 22, 1910. | NUMBER 17

ELECTRICAL EQUIPMENT OF COPPER QUEEN MINE

BY WALTER CREASEY.

Electricity is an important factor in the operations of the Copper Queen mine at Bisbee, Arizona, one of the greatest copper producers of the world. In addition to a complete underground electric haulage system, electric power is utilized in the operation of conveyers, machine shops, pumps and small hoists.

Three-phase alternating current is supplied at 2300 volts, 60 cycles by three 500 kw. Curtis vertical steam turbo generators operated at 1800 r.p.m. Direct current at 125 volts is furnished by a 25 kw. Westinghouse motor generator set taking 2300 volts on the a.c. side, and at 250 volts by two 150 kw. General Electric rotary converters, the latter being for the mine haulage system.



Copper Queen Central Power Plant

The company generates its own power at the central plant illustrated herewith, transmitting at 2300 volts to the various points of utilization. The prime mover is steam which is obtained from five 500 h.p. Stirling boilers equipped with Green economizers and superheaters and burning oil. Feed water is supplied by two electric pumps, driven 25 h.p. 250 volt d.c. Westinghouse variable speed interpole motors, and by auxiliary Dow steam pumps.

Compressed air for the hoists and drills is supplied from two Ingersoll compressors each of 3000 cu. ft. capacity, and one Nordberg compressor of 7000 cu. ft. capacity.

The main switchboard consists of three generator panels and 16 feeder panels, all feeders being metered at the switchboard by General Electric and Sangamo

put of the generator is limited to the amount of current it will carry without injurious heating, and naturally, if part of this current is wattless, the full power rating of the generator cannot be realized. The actual energy available from generators carrying their full rated current is shown by the power factor at which it is operating; thus, a 1000 kw. generator at 70 per cent power factor can deliver but 700 kw.; 30 per cent of its capacity and of that of its prime mover being unavailable.

The extra field current required to maintain the voltage of a generator supplying an inductive load, increases the field losses and may result in dangerous heating, or even call for a voltage beyond the range of the exciter. This extra field is active in circulating the wattless current demanded by the load. The inherent regulation of both generator and transmission line is demoralized by the circulation of the wattless current and poor service results.

When two or more generators are operating in parallel, supplying an inductive load, the necessary magnetizing current may be supplied by operating all the generators at the power factor of the load, in which case each unit bears its proportionate share of the wattless current, or some of the generators may have their fields increased, which results in their carrying more than their share of the magnetizing current and relieving the other generators by the same amount. The over excited generators operate at a power factor less than that of the load, while the power factor of the others is higher than the power factor of the load. By adjusting the field current of one or more of the generators to a value which reduces the armature current to a minimum, we make this generator operate at 100 per cent power factor, while the others carry the wattless current dropped by this machine, and have a power factor much lower than the load. Of course, the best arrangement is to operate all the generators at the power factor of the load and to let each take its proportionate share of the wattless current. In cases where one or more of the generators have fields more liberally designed than others, it is but right that these machines should take a larger proportion of the wattless current. Unless there is some other synchronous apparatus on the line, there is no way of relieving the generating equipment of this magnetizing current.

A synchronous motor on the system has its excitation provided from an external d.c. source, and should, therefore, require none from the line. This is the case, provided a field current of the right value is provided, in which case, the motor operates at unity power factor. If the field is weaker, the extra excitation is provided by a lagging current drawn from the line, which has the effect of assisting in magnetizing the field poles to the proper intensity in a manner similar to the magnetizing action of lagging current taken by an induction motor. If, on the other hand, a greater field current is provided than that which gives unity power factor, a leading current flows which has the effect of partially demagnetizing the field poles, resulting in the proper value of magnetization. Another way of regarding this would be to consider that the excessive field of an over-excited synchronous motor is translated into alternating current excitation available to partially supply that required by the various induction motors on the system. The effect of an over-excited synchronous motor is, therefore, to act as a generator of magnetizing current. This is wattless, so that a synchronous motor running idle, with over-excited fields, requires no power to drive it, beyond that to overcome friction and windage and to supply the iron and copper losses.

Motors used in this way are called rotary condensers and are coming to play a more and more important part in the operation of large power systems.

While it is perfectly practicable for the generating equipment to supply the magnetization required by an inductive load, the rotary condenser affords a cheaper and better way. The generators are frequently slow speed units with heavy engines and large boiler and condensing plants. It has been shown that the wattless magnetizing current renders part of the capacity of the generator unavailable, and at the same time the engine and boilers are but partially utilized, and the investment of the unused portion lies idle. Moreover, if this wattless current can be generated near the place where it is to be used by the inductive load, it will save large line losses and greatly improve line regulation.

A rotary condenser can be a high speed machine and be so designed that a given amount of material will give much greater k.v.a. output than is possible in the case of a generator. The net result is that a given amount of wattless current can be provided from a synchronous condenser at a much less cost than if the generating equipment is left to provide it.

The operating engineer supplying loads at low power factor has this system of supplying excitation forcibly presented when his plant reaches its limit in current, and consequently in output; while his prime movers are far from fully loaded, and the energy he is selling considerably less than the rating of his machines. He faces the necessity of purchasing more generating equipment with its prime movers and complicated accessories, or a less expenditure for a rotary condenser. The latter costs but a fraction of the former.

If he desires to install such a device, the proper location presents an interesting and important question. Since the rotary condenser is to provide magnetizing current to the inductive load, it follows that the nearer this machine is placed to the center of the load, the less distance the wattless current will have to be transmitted. If the condenser is placed in the power house, the generator will be relieved of wattless current, but this will have to be carried to the load through transformers and lines and will benefit the generator alone, while if placed as near the center of distribution as possible, it relieves generators, lines, step-up and step-down transformers of the wattless current.

When deciding on the size condenser to use, it is well to bear in mind that such a machine can also drive a mechanical load without greatly reducing its capacity as a condenser. The power component required to supply this mechanical load is at right angles to the wattless component, so that the total current, which is of course the limiting feature, is but little increased. A mechanical load of 20 or 30 per cent of its rating can be carried by a given synchronous motor, and the capacity of the machine, as a condenser, be

lowered but three to five per cent. A rotary condenser will drive 70 per cent of its rating in mechanical load and at the same time produces 70 per cent of its rating in wattless magnetizing current. It is thus seen that by sacrificing 30 per cent of its capacity as a condenser, we have available 70 per cent of its rating for use for mechanical work. It follows from this that when buying a synchronous motor to do a piece of work, the selection of a machine 30 per cent larger than necessary will permit the production of 70 per cent of its rating in magnetizing current, and relieve the generating equipment, lines, etc., by this amount.

In general, no attempt should be made by means of a rotary condenser to raise the power factor of the system much above 95 per cent. This is due to the fact that a given amount of wattless current introduced into a system is much more effective at low power factors than at high. Suppose a system operating at 70 per cent power factor and with the generators supplying all the magnetizing current. If they are carrying full current, 30 per cent of their capacity is usurped by the wattless current. The supplying of a certain amount of wattless current from a condenser will raise the power factor to 95 per cent and thus redeem 25 per cent of the generator capacity. To raise the power factor to 100 per cent and thus realize the full capacity, would require approximately double the condenser output mentioned, and the additional capacity gained would only be five per cent. From this case the force of the first statement in this paragraph is apparent.

The amount of wattless current given out by a rotary condenser is easily adjusted by the field, and hence a given condenser can be used to correct the power factor of a system under varying loads and power factor conditions. By means of a Tirrill regulator, a constant power factor can be maintained on the transmission line at the point of installation of the condenser, or it can be arranged to hold a constant potential regardless of the load or power factor of the line, the regulator changing the field current and drawing over the line leading or lagging current in such quantities as will act with the line constant to give a uniform voltage.

Mechanically the synchronous condenser resembles the familiar revolving field synchronous motor, but is equipped with a lighter base, shaft and bearings, if it is to supply no mechanical load. The pole faces of the field are equipped with copper bars which are connected on the ends by short-circuiting rings, similar to those of the squirrel cage induction motor. This short-circuited winding aids in starting and prevents hunting. Starting is easily accomplished by supplying a reduced voltage to the armature by means of a compensator, the field circuit being open to prevent injury to the field windings by current which would be circulated by the high induced potential. After the machine has reached full speed, which requires twenty to thirty seconds, the field switch is closed and the full potential thrown on the motor. The current drawn from the line at starting and the time to come to speed are approximately the same as required by an unloaded squirrel cage motor of the same rating.

I have endeavored to show that all inductive loads require a wattless magnetizing current which is usually supplied by the generating equipment; but that this method of tying up expensive machinery is undesirable; and that the rotary condenser offers a cheaper and better way of supplying this current, and permits the supplying of excitation at the exact point where it is needed. The use of synchronous motors in a transmission system should be encouraged, and these should be 30 per cent greater capacity than necessary and the extra capacity used to produce wattless magnetizing current. That a rotary condenser with the addition of a regulator permits of automatic voltage regulation at the end of a long transmission line. The universal effect of the addition of a rotary condenser is to greatly improve the voltage regulation and give better general operating conditions in other respects.

Characteristics of the Induction Generator.

Certain difficulties, arising in the operation of synchronous generators, such as speed regulation, with the number of plants in multiple and difficulty of regulating the voltage between such plants, together with synchronizing difficulties, to say nothing of the simplicity and ruggedness of this type generator, make the operating engineer turn to this device as a possible solution of some troublesome operating conditions.

The characteristics of the induction motor are so well known that it is not necessary to refer to them here, beyond pointing out the action of this type of motor above and below synchronism. An induction motor as such always rotates at a speed less than synchronism, the difference between actual and synchronous speed being called the slip. It depends in a given case upon the load. The torque of such a motor is proportional to the product of the magnetic flux set up by the primary and the current in the short-circuited secondary, the latter current in turn depending on the flux cut by the conductors of the rotor, and hence on the slip. If an induction motor is called upon for a torque in excess of that which it is delivering, an adjustment at once takes place by the rotor slip increasing till the additional flux cut by the secondary conductors sets up a current in the short-circuited rotor, which is sufficient to produce the greater torque required. As the load is reduced to a minimum, the speed of the motor rises to nearly synchronism, the secondary current and the torque fall, and if the machine is driven at exactly synchronous speed, both become zero. The motor at all loads takes a certain magnetizing current, and this is present even if the rotor is driven at synchronous speed. If driven above it the rotor bars cut the primary flux in the opposite direction, resulting in a reversal of the secondary current and, therefore, of the torque. In other words, the machine requires mechanical power to drive it above synchronism and hence has become a generator.

The change from motor to generator is analogous to the action of a shunt wound motor when connected to a direct current source and driven above the speed at which it would operate as a motor. When driven in this manner the counter e.m.f. of the armature is higher than the impressed voltage and a reversal of current takes

place and the machine gives out energy, hence it becomes a generator. In the case of the induction motor, armature reaction is always present tending to weaken the primary flux. When such a machine is connected to a proper alternating current source and driven above the synchronous speed of such source, the rotor bars cut flux in the opposite direction, and a consequent reversal of current takes place in the armature. The armature reaction now aids the magnetization of the stator iron, where in the case of the motor it tended to weaken it. As the speed above synchronism is increased, the sum of the flux set up by the true magnetizing current drawn from the line, and that supplied by armature reaction of the rotor, tend to magnetize the stator iron to a density greater than normal. The iron of an induction motor, just as in a transformer, must operate at a practically constant density regardless of the load, and the tendency of the armature reaction to increase the flux causes a flow of current into the line. The current thus generated in turn demagnetizes the iron and maintains the flux at the proper value. There is a definite armature reaction for any given speed above synchronism, and it follows that there is a corresponding definite current output by the induction generator.

It is a fundamental characteristic of this type of generator that it cannot deliver leading or lagging current and can only supply power current to a circuit which can provide it with a wattless magnetizing current. For a given speed above synchronism, the amount of current it will deliver is fixed. These apparently rigid and inflexible conditions have in the past prevented the extensive use of this type of generator.

The power output of an induction generator depends upon the primary flux and secondary current, the latter, in turn, being dependent upon the speed above synchronism. The density of the primary flux in a given case is fixed by the voltage. Under conditions of short-circuits on the system, the voltage of the synchronous generators drops, with the result that the current producing power of the induction generator falls at the same time, due to the dying out of the primary flux, and such a generator, therefore, cannot supply current to a short-circuit. On large cable systems, and where a short-circuit involves a tremendous amount of power, this characteristic might be of great value. On a cable system, also, the charging current of the cables would partly supply the magnetizing current required by the induction generator and remove to some extent an objectionable feature of this type of machine.

High speed steam turbine work seems to be the most promising field for induction generators, since the simple mechanical construction of the squirrel cage rotor permits a high speed and high operating temperature without injury to the machine. It has also been proposed for gas engine work where parallel operation of synchronous machines is usually secured at the expense of heavy fly-wheels and elaborate damping devices on the pole faces, and where even with these, successful operation is not always possible. If instead of synchronous units, induction generators were installed having high speed synchronous motors running light to supply the excitation for the outside load and for the generators, there would be no necessity of limiting the angular variation of the gas engines to the present very exacting figures. Any demand for more load comes first on the synchronous motor, causing it to drop slightly in speed, with the result that the induction generators running at a constant speed would have their slip above synchronism increased and the load would be automatically transferred to the induction generators. The voltage of the system would be controlled by a regulator working on the direct current exciter of the synchronous motor.

The same arrangement has been advocated for water-wheel driven stations or a modification of it to the extent of having a number of wheels drive synchronous generators, and the remainder induction generators, thus doing away with hunting and exchange currents between the machines, and also with governors on the wheels driving the induction type generators. It might also have a place in the development of a stream where no storage was available, and where the plant is a part of a large system and must be cheaply operated. This station could be run without attendants by having an induction generator tied to the line and the water always turned on. The generator would run above the synchronous speed of the system till it took a load equivalent to all the water available. If the water supply should be interrupted, the induction generator would run on the system like an unloaded induction motor. If in any manner it were disconnected from the system, it would simply run at from 50 per cent to 70 per cent above the no load speed, and no harm would result.

If the synchronizing of an alternator is not perfectly done, an instantaneous rush of current results which is limited only by the resistance and the true reactance of the winding, and frequently reaches fifteen to twenty times normal value. The strains on shaft and windings may be many times normal and result in injury to the machine, or result in annoying delays due to opening of the switches by the heavy rush of current. With the induction generator, there is no necessity of synchronizing with the system, the induction machine being simply to run up the speed if thrown on the line in series with a reactive coil (reactive coil is then short-circuited) and the generator is automatically excited from the system and takes a load proportional to the power input.

In cases where the induction generator is used, the synchronous machine acts as an exciter supplying alternating magnetizing current. The volume of this wattless current, however, becomes so great that the induction generator cannot bear any great proportion to the capacity of the synchronous units, or the latter will be so loaded with wattless current that their capacity for useful work will be seriously reduced. For instance: an induction generator having a full load power factor of 90 per cent will require a wattless magnetizing component of 43½ per cent of the full load current, and if a case is taken where the synchronous generator is the same size as the induction motor and the combined output is supplied to a load having a power factor of 100 per cent, the power out-

put of the synchronous generator cannot exceed 87½ per cent of its rating, due to the heavy magnetizing current required by the induction generator. If the load were at 95 per cent power factor, all but 35 per cent of the capacity of the synchronous machine would be required to supply the magnetizing current of the load and the induction generator. If the power factor of the load is 90 per cent, but 6 per cent of the synchronous generator is available for useful work, and if the power factor of the load were 88 per cent, all of the current capacity of the synchronous generator would be required for magnetizing current of the induction generator and of the load.

In case the synchronous generator is twice as large as an induction machine, conditions are much better and are as tabulated below:

Power Factor of Load	Per cent Capacity of Synchronous Generator Available for Power Load.
100	97
95	75.2
90	62
80	39.9

If the combined induction generator capacity is one-fourth or less of the synchronous capacity, the wattless magnetizing current becomes an unimportant part, but by the same reasoning, the gain which such a machine effects, is also correspondingly reduced. A power factor of 90 per cent for full load for such a generator is perhaps a little low, but with machines of small size, and especially of slow speed, much better results would not be obtained. Turbine driven machines of 1000 to 3000 kw. capacity, and running at 1500 or 1800 revolutions, can be designed with a full load power factor of 95 to 96 per cent, and with such a machine the magnetizing current would not be such a drag on the system—though situations where generators of this size could be used would be relatively rare.

In trying to find why the induction type of generator has not been used to any great extent, we are confronted by a number of serious objections to this type of machine. It is distinctly a secondary and dependent piece of equipment, unable to function unless in connection with synchronous generators. It is unable to produce any wattless current, of which most modern systems require considerable. It requires such a large magnetizing current that the induction generator can bear but a small proportion to the capacity of the synchronous machines, and its good effects are consequently reduced.

While the simple mechanical construction should make the cost of such a machine less than that of the more complicated synchronous generator, heavy engineering and development charges will have to be borne by the first machines produced, which will probably make them cost more than the synchronous generators. There has been practically no demand for this type of generator, which shows that as yet the American power station practice does not consider that the advantages of the induction generator can off-set its many disadvantages.

MUNICIPAL INSPECTION OF GAS AND GAS METERS.[1]

BY WM. SCHADE.

Municipal inspection of gas and gas meters is by no means of recent date, neither is it an imposition upon gas men, nor an infringement upon their rights to conduct their own business to suit themselves, as many have and perhaps now suppose it to be. Municipal inspection is as old as the gas business itself, and a natural adjunct to the business.

In order to make myself clear and substantiate my position, I beg your kind indulgence in a brief review of the early history of the gas business. I sincerely believe there are many gas men now, perhaps members of this association, that are not at all familiar with the early struggles for the introduction of artificial gas as a commodity or public utility, and it may therefore be of interest to them.

England is undoubtedly the mother country of the discovery and practical application of artificial gas as a public utility, as well as to the regulation of prices for gas and the quality thereof. Nearly two centuries ago illuminating gas was first artificially distilled from coal in heated iron retorts, and the gas thus obtained was called "spirit of coal," but was never put to a practical use there (notwithstanding that a number of men experimented continuously with this process for about seventy-five years) until the close of the eighteenth century, when Mr. William Murdoch lighted his own house at Redruth in Cornwall with coal gas. Coeval with Mr. Murdoch's experiments were those of Mr. Lebon in France, who both lighted and heated his own house by this means, and also made his first exhibition of "light" in Paris in 1802. But it remained for England to make a public practical application of this great discovery, and through the untiring efforts of Mr. F. A. Winsor, one-half of Pall Mall, London, was lighted by gas in 1807.

The great advantage of gas light for streets and public buildings became apparent, and in the year 1809, Parliament was appealed to for an "act" granting permission to incorporate a gas company, which was granted in the following year. From the foregoing statements it will be seen that as early as 1809 Federal aid was enlisted by those who intended to enter the business of manufacturing and distributing gas for public use, which subsequent events proved to be a wise move, and while in consequence of this act many gas companies sprang into existence, frequently in such keen competition with each other that some of them almost went under, which was not to be wondered at, taking into consideration the absolute inexperience and the crude method of production, as well as distribution. As late of 1850 some companies' shares valued at $250 each could not be sold for more than $6.25. The outlook was indeed gloomy for some of these companies. Parliament was again appealed to, and under the pressure brought to bear upon the gas companies by this legislative body, amalgamation of many companies, as well as districting the territory, was speedily effected, which received the sanction of Parliament in 1860.

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, Los Angeles, September, 1910.

From this time on the use of gas as a commodity spread rapidly all over England, France, Germany and the United States of America.

Simultaneously with the assistance given the companies and the establishment of a fixed rate per thousand cubic feet of gas, guaranteeing a ten per cent profit on the investment, besides a suitable reserve, Parliament realized at once the necessity of also protecting the rights of the people, which it did without delay by creating a commission to be appointed by the "Board of Trade," whose duty it was to see that justice and equity prevailed between producers and consumers, concerning the rates to be charged for gas, and whenever the books of the companies showed an earning in excess of the guaranteed ten per cent and a suitable reserve, the rate per thousand feet was reduced; and so admirably did it work that in the course of twelve years the price of gas had been reduced from $3.75 to 93 cents per thousand feet. Parliament also appointed at the same time three "Gas Referees" (expert chemists) whose duty it was to make daily tests of the gas produced to see that the established standard of the illuminating candlepower and purity was maintained and strictly adhered to. The necessity for creating the position of municipal inspector arose principally from the fact that the effect of inhaling the impurities and the offensive odor accompanying the combustion of gas in the homes of people was so objectionable that it greatly retarded the introduction of gas. The science of chemistry of gas manufacture and purification was then in its infancy. It became imperative, therefore, that competent men should be placed in charge, independent of the companies, to see that the people received honest value for the honest dollar the government had asked them to pay the companies. This was not derogatory to the interests of the companies by any means, but the natural sequel of the then existing conditions, a decided advantage to all concerned and the only proper thing to be done. On the one hand, it saved the companies the employment of a chemist, the installing of a costly laboratory, and yet they knew at all times the exact condition of their gas. On the other hand, the people felt more secure in having their interests officially taken care of. This was soon recognized wherever gas was used and municipal inspection became universal in England. Birmingham, Manchester and other large cities adopted rules and regulations as early as 1864.

I do not wish to be misunderstood concerning the last two statements. I am highly in favor and heartily recommend that every first-class gas plant should have a laboratory, with a competent man in charge of it, and every gas manufacturer should urge in his respective community (for his own benefit if nothing else) the creation of the position of municipal gas and meter inspector. Not only can you check up the work of your own man with him, but you can also unload any amount of complaints upon his shoulders without cost, and the result is usually satisfactory, speaking from experience, and I believe it will receive the endorsement of all the representative men of the three companies operating in Los Angeles. I wish to state right here that municipal inspection of gas and meters is absolutely sane, logical and the proper thing to have, for the results are as far reaching in their benefits to the companies as they are for the public, and any man thinking otherwise should change his mind at once. In every well-regulated civilized country everybody expects either Federal, State or municipal inspection of every public commodity and we should encourage it here.

This, I think, will be sufficient on the municipal inspection of gas, and I will now take up the other part of the subject—municipal inspection of the gas meter.

Had I the tongues of men and of angels, or the gift of speech of the greatest orators the world ever knew, I would not dare to attempt to adequately describe the flow of language (profane and otherwise—mostly profane), the engendered feelings of hatred and passion, that this little innocent, inoffensive thing, "this outward monitor" of man's inward passion, is guilty of, this bone of contention, this bugaboo of all the bugaboos in the gas business, this "perpetual" motion machine, which according to public opinion fills the coffers of the gas man, obeying the will of its master, jumping up and down according to his needs and wants financially, and the amount the public can stand, this best and most faithful friend the consumer ever had, never affected by the misreadings of the man who reads it, never trying to wreak vengeance for the abuse it suffers; now it is exposed to the glaring, burning sun by day and the cold and chilling dampness of the night, then again it is tossed about under some shack sunk half way down into mud and slush; then again it is exposed to the sprinkling by the garden hose and made a target for stones thrown by mischievous neighborhood boys, and so forth and so forth; never occupying a decent place in the house of the consumer as it should, yet it is ever faithful, ever true, but because people do not know or understand the construction or operation of a gas meter they express their erroneous ideas according to their feelings. It is essential therefore, that somebody should educate the people on the gas meter and testing it when necessary, and what would be more proper than having a municipal inspector for this purpose?

In conclusion, I beg to say, that being conscious of the fact that however interesting, a paper may be too long, and thus becomes tedious, totally defeating the intentions of the writer. I have made but a brief reference to the history of gas lighting, as many of you have no doubt discovered. For instance: There was Von Helmont, the earliest experimenter in our business, and who first called his discovery "gheist" (ghost), or as I have translated it "spirit of coal"—hence our word "gas." Samuel Clegg, called by many "the father of gas making," and to whose inventions of various apparatus, (many of which are used to this day) among which is the gas meter almost as we have it now, we are greatly indebted, and many others you no doubt know of. In connection with this subject it may be permissible to remind you of the earliest successful American governmental gas inspection, viz: the "Board of Gas and Electric Light Commissioners of Massachusetts." The beneficent results of the labors of that commission has been so much appreciated by the people and by the corporations alike that at last it has caused the institution of similar bodies in other States; and thus I trust I have made good the main points as set forth in the title of this paper.

BOILER EFFICIENCY WITH OIL AS FUEL.

Tests have been recently made on the Canal Zone at Los Cascadas air compressor plant and at the Mount Hope pumping station to determine the economy and efficiency of the boilers, with California crude oil as fuel. These tests are similar to those made at all the large boiler plants in the Canal Zone, a summary of which was published in the Journal of Electricity, Power and Gas of July 2, 1910.

At Las Cascadas, the test was made on six return fire-tube boilers, and consisted of two trials of 7½ and 9 hours, respectively. The first trial was made while the plant was operating under normal running conditions, while during the second, an attempt was made to increase the economy and efficiency by decreasing the amount of air supplied to the furnace for combustion, closer regulation of the oil and steam used by the burners, and by operating the boilers at their full rated horse-power. The second trial showed an economical adjustment of the burners (two to each boiler), which was verified by the high evaporation of water per pound of combustible, and very little improvement could therefore be made in this respect. The increase in economy was obtained by decreasing the amount of air supplied to the furnace for combustion, by closing the ash pit doors and dampers, and by operating the feed water pump at a constant speed, keeping about one and one-half gages of water in the boilers throughout the test. Some results of the test are as follows:

	Trial 1.	Trial 2.
Horsepower developed	1,442.58	1,507.82
Equivalent evaporation from and at 212 degrees F. per pound of oil.............lbs.	13.931	14.404
Equivalent evaporation from and at 212 degrees F. per pound of combustible....lbs.	14.154	14.635
Cost of fuel for evaporating 1,000 pounds of water under observed conditions..........	$0.2528	$0.2437
Cost of fuel for evaporating 1,000 pounds of water from and at 212 degrees F........	$0.2365	$0.2287

At Mount Hope the test was made on one locomotive type boiler, the first trial being to determine the economy and efficiency under normal running conditions. A comparative trial was then made for the same length of time (16 hours), to see if an increase in economy could be obtained by decreasing the amount of air supplied to the furnace for combustion, carrying a boiler pressure of about 80 pounds gage, 1½ gages of water, and by closer regulation of the oil and steam used by the oil burners. The results of the second test show that a considerable increase over the first test, both in efficiency and economy, was obtained, principally by decreasing the supply of air to the furnace, close regulation of the oil burners, and carrying a higher boiler pressure. The results for the test were as follows:

	Trial 1.	Trial 2.
Horsepower developed	77.96	86.87
Equivalent evaporation, from and at 212 degrees F., per pounds of fuel, as fired..lbs.	10.75	13.11
Equivalent evaporation, from and at 212 degrees F., per pound of combustible....lbs.	10.99	13.40
Cost of fuel for evaporating 1,000 pounds of water under observed conditions......	$0.3365	$0.2759
Cost of fuel for evaporating 1,000 pounds of water from and at 212 degrees F......	$0.3064	$0.2513

OIL OPERATIONS IN MEXICO.

During the last few years this section has been explored by expert engineers and geologists, with the result that it has become generally understood that the Gulf coast of Mexico has great possibilities as an oil field. Over a score of companies, including the largest and most powerful oil interests in the world, have been engaged in the work of exploring and develing; millions of dollars have already been spent; hundreds of dollars worth of machinery has been imported for this purpose; a small army of engineers, geologists, and drillers has been kept busy.

Until recently the only success obtained in this field in the immediate vicinity of Tampico was that of the Mexican Petroleum and Development Company in what is known as the Ebano field, about 35 miles from Tampico. The Pearson interests developed some wells in the Veracruz district, and had some little success in the Tuxpam region. During the last few months the Huasteca Oil Company met with some success in the Juan Casianos field, and recently the Mexican Fuel Oil Company brought in a well at Topila. During July, 1910 the East Coast Oil Company, representing the Harriman interests, were successful with a well at Topila and another at Panuco, As a result of these successes, the value of leases has increased greatly.

The companies already operating in this section include: The Mexican Petroleum Company of California; the Huasteca Petroleum Company, owned by the Doheny interests and an allied company of the Mexican Petroleum Company of California; the East Coast Oil Company, which has as yet no corporate existence, but which represents the Southern Pacific or Harriman interests; the Mexican Fuel Company, a Waters-Pierce Oil Company concern; the Mexican Fuel Oil Company, incorporated under the laws of West Virginia; the Dos Banderos Oil and Gas Company, an Arizona corporation; the American International Fuel and Petroleum Company, which was organized under Delaware statutes; a California corporation, the Tampico Petroleum Company; the Standard Oil Company of Mexico, with home offices in London; the Standard Oil Company of England, with the same official personnel as the preceding company; the Hidalgo Petroleum Company, composed of California parties; the Tampico Oil Company (Limited), an English organization. The operations of S. Pearsons Sons & Co. have been very extensive.

The Electra Petroleum Company is being formed, under English law, to develop leased land near Juan Casianos. A company is organizing in California for work on a hacienda 20 miles up the Panuco river from Tampico, and a Salt Lake City company, which has a fruit farm near Caracol, has oil-drilling machinery on the way for sinking a well about 15 miles from Tampico

Each day is bringing new developments. Outside of the fact that a number of companies had to cease operations until the close of the rainy season, the prospects are brighter than they have ever been before, and it is confidently expected that the Gulf coast will shortly become a great producing field.

THE PUBLIC SIDE OF STREET RAILROADING[1]

BY PATRICK CALHOUN.

No men, not even those engaged in public life, come in such close contact with the people of the cities as those who manage their daily transportation. From this contact we learn an important fact—the utter indifference of the general public to what may be termed the private side of street railroading. How many of the general public do you find who understand the tireless energy, the constructive genius, the wasted experiments, the tremendous labor which have been required to develop the art of electrical transmission necessary to propel economically a street car? How many who realize the vast sums expended during the past 25 years in constructing, first, the horse-car lines; their conversion into cable lines, and then the conversion of the cable lines into electrical lines; or the amount wasted in abandoned electrical machinery? And yet, many modern, up-to-date railroads represent the entire cost of these successive stages.

Theoretically, the public side of the question should be confined to these propositions:

(1) That the complicated machinery and organization of a street railroad system shall result in cheap, first-class and efficient service.

(2) That the best methods of granting the use of streets for transportation purposes shall be adopted, and full payment be made for such use.

(3) Whether a higher return for the use of the streets and a better and more efficient street car service thereon can be more cheaply obtained through public than through private operation.

These propositions involve non-political questions of a business nature. Their discussion should create no heat and arouse no rancor. All classes are interested in their correct solution. In every city of the country the problems of street railway transportation are receiving the attention of the most skilled and competent men, yet, no questions affecting our city life have created more virulent, demagogic attacks, have been discussed with less intelligence or more bitterness. The politician, the yellow-journal, and the muckraker have combined to misrepresent the position of the railroads. Managers and owners are falsely charged with being the chief source of corruption in city government, and the effort is being made to separate them from the balance of the community. They are denounced as the enemies of society. The result of these attacks has been in a notable instance, in the city of Cleveland, to throw a perfectly solvent, splendidly managed property into the hands of receivers; to make many conservative investors fearful of the future of the securities of street railroads, and to place such securities in the speculative, instead of in the investment class, where they belong properly.

The reason for this is two-fold: The railroad management is brought in contact with every phase of city life; every character of request for assistance is made upon it, from a contribution to a church bazaar, to a contribution to an international exposition; from furnishing a special car for an infant's baptism, to a funeral car for a man's last ride; from the just demand for increased service during the busy hours of the day, to the unjust demand of the real estate speculators that unprofitable roads should be built into unpeopled suburbs. No other business comes in contact daily with so many people, so touches the daily life of the citizen, or is so important to the orderly conduct of the people's business.

The railroad has no control over the street traffic. Oftentimes its tracks are the only well-paved part of the street; wagons and teams crowd upon them, and an inefficient or inimical city administration, neglectful of the people's comfort, allows the ordinary street traffic to delay the cars. The hurried and impatient patron, who does not see the cause, blames the railroad for the delay. While a large majority of the people are reasonable, the railroad must haul all kinds, the halt, the lame, the old, the blind, the thoughtless, the careless and the impatient. The inconvenience necessarily incident to the surface transportation of all large cities breeds discontent and creates a fertile field for the agitator.

And this brings us to the second cause for the attacks upon street railroads. There is a growing class of men in all of our cities, socialistic in their views, some sincere, others insincere, who desire to create that condition of unrest and distrust which will prevent further street railroad extension and bring about municipal ownership. With this class the end justifies the means. No attack is too wicked, no misrepresentation too false, provided it aids in the creation of public sentiment in favor of municipal ownership.

Allied with these men are local agitators and ward politicians who hope through municipal ownership to acquire jobs for themselves, or increased power through the increased patronage which would some from public operation.

Allied with both of these are the unscrupulous demagogues who seek support, frequently as reformers, sometimes as progressive reformers, through fostering unrest and discontent, and who believe that so great is the unrest and discontent of the country that popularity and power are to be gained through attacks upon corporations. Occasionally this demagogue is a practical politician who declares that the interests must be driven out of politics, while he seeks to extort excessive fees or campaign contributions from the railroads on the ground that he alone is strong enough to protect the corporation from the attacks of its enemies. The logic of his position is this: The corporate manager cannot and should not take an active part in local affairs. To do so will render the road unpopular. The managers therefore should stand aside and rely upon others to protect their interests. Publicly this politician will declare that he seeks to drive the corporations out of politics; secretly he will say to the corporate managers that he proposes to protect their interests and they can rely upon him. Under this system the corporation finds itself with no means of protection except the good will of the political boss. It has been and will continue to be open to cinch-bill annoyances and blackmail of every character. There is but one safe rule. A politician who will not enter by the front door should be barred from the back door.

There is not an intelligent street railway manager

[1] Abstract of paper presented at meeting of the American Street & Interurban Railway Association, Atlantic City, Oct. 10-14, 1910.

in the country who does not desire to keep his corporation per se out of politics. No class of men is more opposed to corrupt alliances between the corporations and politicians; no men more earnestly favor the overthrow of the boss system in party management; no men more sincerely desire non-partisan discussion and non-partisan action in regard to the serious business problems involved in city transportation; no men are better equipped to help the people arrive at correct conclusions on this subject; no men have greater selfish interests or broader patriotic motives in seeking the proper solutions of the problems; no men will unite more cordially with their fellow citizens in an effort to better conditions, materially and morally. They believe earnestly that the railroad companies and the problems involved in their operation should not be made the targets of political attacks, but should be left unmolested, subject to public, non-partisan control, to carry on their business.

They know that co-operation between the railroad, the general public and city officers—cordial, sympathetic, will co-operation—is an essential to efficient service. In some of our larger cities intelligent police regulation of the general traffic of the street has become most effective in preventing blockades and in keeping the street car tracks free for public use. It is only through such regulation, which the railroad itself cannot enforce, that delays can be prevented.

There are two methods by which corporate interests can be protected. One is by their officers and officials apparently abstaining from politics, apparently devoting themselves entirely to business, claiming to be business men and not politicians, and making secret deals with those politicians who will give them protection. This has been in some degree the method of the past, and this has been unquestionably a cause of political corruption. The corporation, without a just public opinion upon which to rely, has found itself without any defender except the corrupt politician, whether under the name of reform or machine, who has demanded his price for his protection.

The other method is for the corporate manager to defy boldly the politician, high or low, who undertakes to drive him from a participation in public affairs; to refuse to be blackmailed, to refuse to buy political protection through campaign contributions, to put his trust in the plain people of the country, and, willingly, boldly and fearlessly lay his case or his needs before them.

I advocate, absolutely, clean political methods—bold, fearless, courageous methods—and the establishment in every community, by the men who manage corporations, of a reputation for tearless political courage, until they secure a leadership in civic affairs recognized to be disinterested and for the public good.

I advocate a campaign of education, the widest publicity of the affairs of public service corporations, freedom from entangling political alliances, the sternest integrity in the administration of both the private and the public side of corporate management, and the passage of such laws as are necessary to establish non-partisan tribunals of a judicial rather than a political character, with power to grant franchises and regulate public service corporations.

One of the causes of political distrust of the corporation today is that corporate managers have sometimes professed to be out of politics, while they have had secret deals with the demagogue who has been proclaiming his desire to keep the railroads out of politics.

I have in mind the picture of a scene that occurred in the office of the Governor of one of our States. He was in discussion, friendly and cordial, with the general counsel of a railroad. While this discussion was going on some of his farmer constituents appeared at the door of the executive office. The back of the railroad counsel was to the door; the Governor faced it. He saw his constituents, immediately raised his voice, and said, without pertinency to what was then transpiring, "I tell you, sir, I will not allow myself to be dictated to and controlled by the hireling of any corporation," and launched into a tirade against railroads. His constituents paid their visit and left, when the Governor apologized for the abrupt change in his manner by the statement that it would never do for him to be found in friendly conversation by his country constituents with a corporation lawyer.

These facts are calculated to make cynics of railroad managers, and distrustful and suspicious voters. I am an opponent of corruption, a contemner of hypocrisy, and an advocate of widest publicity. Why should we leave the field of publicity to the muckraker and the demagogue? The people in the end are the arbiters of our destinies; the great bulk of them are honest, upright, sincere, truthful; they hate a liar, and if the demagogue lies and gets off with his lies, it is because he is not exposed and the people are not convinced of his malevolence and untruthfulness—they too frequently attribute his misstatements to mere impulsiveness. But the railroad man, whose corporation will continue to operate after his day is past, cannot afford to lie; he must be truthful, plain spoken and upright. He has not only his own moral character and personal future to regard, but also the trusts which are imposed upon him, in behalf both of the stockholders and of the public whose servant he is.

There is no doubt that a campaign of lies has been inaugurated and is being carried on by our opponents. Why should not the railroad interests of the country inaugurate a campaign of truth and go before the people confident that the campaign of truth will win out over the campaign of lies? They may meet with temporary defeat here and there. What of it? Defeat should only be an inspiration for more vigorous action if a man is armed with conscious integrity. The time is ripe for a movement of this character.

We represent one of the most honorable of occupations, one that requires a high order of executive ability and a high order of technical information. The men who manage the railroads are patriotic, upright and honest. They have the capacity to express themselves, and the means at hand of laying their views before their fellow citizens.

We know that no men are so interested in the material welfare and growth of a city as those who own its street railways. We must make the public know this too. The rate of fare is fixed; it cannot be increased, and there is no possible way by which gross earnings can be increased except through increased population. The public must be educated to recognize

that there is no conflict between it and its railroad managers. No men are willing to work harder, more patiently, more effectively for the public welfare. No men are more interested in good government—not the bastard sort of the reformer for office, but careful, prudent, economic, efficient, honest government.

Now, you cannot eliminate the corporations, and the men connected with corporations, from an interest in public affairs. They pay taxes; they meet the public in every direction; they want careful, prudent, economical government; they form a part of the best life of the country. It is foolish to assume that under modern conditions corporations can be destroyed, or that it would be wise to destroy them if they could be destroyed.

A bold, frank, open courageous course will give any man a standing, whether he is a corporate manager or whether he is not, in any American community. The people will listen to what he has to say, if they believe truth and honesty are in his words, backed by strength and character.

Railroad managers should take an active leadership in providing the best method by which franchises may be granted with the least temptation to corruption and the best results to our cities. This is a subject upon which all good citizens should unite. Corporate managers do not desire to overreach the people in acquiring new franchises.

No greater misconception exists in the public mind than that the franchises generally of street railways have been founded in corruption. As a matter of fact these franchises were originally granted to the foremost men in their respective communities, often influenced by a noble public spirit and the desire to give to their communities the transportation absolutely essential to a city's growth. They were granted when the risk in street railway construction was great and when the communities were more anxious to grant the franchises. In many cases, too, they became burdens instead of benefits to the promoters and yielded no profits for many years. Such corruption as has existed has grown mainly out of efforts to procure speculative franchises in opposition to the old established roads, most frequently not to give any needed transportation, but for the purpose of levying blackmail upon the older enterprises through forcing them to purchase the new grants.

We may admit, however, at the start in the discussion of this subject, that the present method, by which the State grants a charter to a public-service corporation, and then leaves it to the local legislative bodies in our towns and cities to grant franchises for the use of the streets and to regulate the rates of public service corporations, has been the source of corruption. The system is wrong. So long as greed is strong in the human breast, so long will you find some politicians ready to hold up the corporations until they have exacted their pound of flesh. Nor will the fact that the public laws controlling the city charter provide for the freest advertisement of franchises for sale to the highest bidder meet the difficulty. A striking illustration of this fact has been found in San Francisco. By the charter of that city today any franchise for a street railroad must be advertised for 90 days and the bidder must pay a minimum amount of the gross receipts to the city government. At the end of 25 years all the property of the railroad passes to the city without consideration other than the grant of the original franchise.

Some of the foremost gentlemen of San Francisco applied to the Board of Supervisors for a franchise to build a railroad through the sand dunes of what is known as the Sunset District. There were no houses in this district and the streets had not been opened. These gentlemen, who were large real estate owners, determined to open an important boulevard at their own expense, and to build a street railroads into this desert of sand for the purpose of developing their property and putting it upon the market. The street railroad franchise was of no value. They knew that it could not be made profitable, and that they would be compelled to charge the money which they expended in the construction of the boulevard and the building of streets to the cost of their real estate. It was manifest that it was to the interest of the city that the franchise should be granted, and yet it was held up for months by the Board of Supervisors. Finally some of the men connected with the enterprise employed a prominent lawyer, who then also occupied the position of a political boss. They paid him a fee. Still the franchise was not passed during his period of political control. Subsequently certain members of the Board of Supervisors were bribed, on a skating rink ordinance, by a set of buccaneer financiers and politicians who had banded together to gain control of the city for personal exploitation. These men offered and gave complete immunity to the Supervisors whom they had bribed provided the Supervisors would incriminate, among others, these land owners in the Sunset District. The Supervisors promptly accepted the price of their immunity, and declared that they had been promised money by the so-called political boss if they would pass the ordinance for the railroad. The land owners who had projected the road and who were ready to build, and did subsequently build, a splendid boulevard at their own expense were promptly indicted. The political bass was also given a written contract of immunity in the hope that he could be forced to incriminate the land owners among others, but it developed that the Supervisors never received a cent of money either from the political boss or from the gentlemen connected with the enterprise. The political boss declared that he had received a fee in connection with the road, but that he had never been authorized, directly or indirectly, to pay or promise any money to the Board of Supervisors, and had never done so, and that he would not perjure himself to convict innocent men. The franchise was held up for nearly three years, when the socalled reform administration granted it under the public pressure which had been aroused and the fear of political retribution if they held it up longer. The result was that a most unprofitable street railroad was built, while the assessor states that real estate values tributary thereto advanced 800 per cent.

Now, no system of granting franchises under which such a condition has occurred, and may recur in the future, is wise or safe. I suggest that the remedy is for the State to refuse to delegate the power of granting franchises and regulating their rates to varied local bodies, too frequently corrupt and irresponsible,

but to reserve this great right to itself; to provide franchise counts or public service commissions composed of a few men of the highest ability, character and integrity, who should have the power to grant franchises only after the fullest public hearing. The court or public service commission should hold public meetings in the different cities and towns. The grant of franchises should be withdrawn entirely from politics and left to such court or commission.

The period when public pressure and the consideration of the public phase of railroading is brought close home to a street railroad manager is during a strike. Then it is necessary more than at any other time for a railroad manager to have a definite conception of his public duties and of his private rights. Tremendous pressure will be brought to bear upon him by civic and religious bodies, well-meaning to the core, but who, without knowledge of the great fundamental rights which lie at the basis of society, are willing to temporize and adopt any expedient which will produce a speedy resumption of traffic.

No man, no set of men, has a right to say to any man he shall not work when and how and as he pleases; no employes of a corporation have a right to abandon their occupation and still claim to have relations with the corporation. I concede to the employes the right to organize for mutual protection, to better their condition, and to stop work when they want to, even without notice to their employer, but I deny absolutely the right of any body of men to leave the service of any employer and say to him, "We will prevent by violence other men from seeking your employment and you cannot carry on your business without submitting to our dictation." No strike can be successful unless the employer is weak enough to deal with the men after they have struck, and industrial strife will necessarily stop if strikes continually fail.

Our government was formed upon the principle that there were certain inalienable rights of man of which the whole of society could not deprive him, and that one of these inalienable rights was free speech, particularly in defense of himself and his property when attacked. The railroad manager himself should seek to deprive no man of his liberty, but he should allow no group of men to deprive the humblest of his employees of the liberty to work if he wants to work and if he is faithful and honest in the discharge of his duties. He must be prepared to defend vigorously the rights of the property entrusted to his care, and that of his humblest employee in his own labor.

No man has so great an interest in the stability of property rights as the honest workman, of whatever calling, who has no property except the property to be acquired through his own labor. No prosperity can exist except where there is the utmost protection and safeguard to the rights of the individual in his property, whether it be in his labor today, or whether it be in the results of yesterday's labor which he has husbanded and saved. All despotic governments which have failed to give full protection to the rights of property have had in them men of large wealth, who, in one way or another, through power or corruption, were able to take care of themselves, but the masses of mankind under such despotic governments have been invariably reduced to the lowest conditions of poverty. You cannot separate the rights of man from the rights of property acquired by his labor without depriving him of his liberty and reducing him to a condition of serfdom. Railroad franchises rest upon the law to the same degree that the title to the real estate fronting upon the streets rests upon the law. Both rights were acquired by grants from government, but the rights entrusted to our care are clothed with a public use, while the rights deprived from a grant to a piece of real estate may be all private. It behooves, us, therefore, more than any other class of men in the country, to study and to understand what are our private rights and what are our public duties.

It is the patriotic duty of the railroad manager, fighting demagogism and socialism on the outposts of society, to stand firmly for the protection of those limitations which form the basis of the liberty of the individual. He must learn and he must teach that our principles of government did not spring from a written constitution, but that our written constitution, carrying with it the protection of life, liberty and property, sprang from principles which were the product of eighteen centuries of conflict with despotic power; that the principles that a contract must be held inviolable, and that the humblest citizen of a community, as well as the richest, has certain inalienable rights of which the whole society cannot deprive him, are necessary in order that the people may prosper and find liberty and happiness in their prosperity; that a government of, for and by the people has no place in it for the political serf or the beneficent ruler; that equal and exact justice to all men can be found only under a reign of law. In this day, when we hear so much of the conservation of our material resources—and every patriotic man wants to see them intelligently conserved and legally developed—I say to you, gentlemen, that the conservation of the country most needs is the conservation of a government of law.

CHINESE COAL FOR UNITED STATES.

On August 10, 1910, a Chinese mining company made a shipment of sample coal, coke and cement to San Francisco, the total value of the shipment amounting to $34,863, the cargo being made up as follows: anthracite, 2000 tons; lump, 920 tons; slack, 1980 tons; special coke, 5 tons; cement, 10 casks. This fact is more significant when it is considered in the light of the recent departure for the United States of a representative of the company, under instructions to inspect the larger towns and cities of the Pacific Coast with a view of discovering a market therein for the products of his company. It means that a definite and energetic attempt is being made by the company to find an opening outside of China for its excess output, and if the attempt is successful, American coal will find a dangerous rival on the Pacific Slope. This company is one of the strongest and best-managed industrial concerns in China, if not the strongest. It has behind it substantial Belgian and British capitalists, and its direction is by an able foreign engineer. Up to the present it may be said to have been in a stage of preparation. It is now in a position to hold its own in the China coal market and to look abroad for other markets to supply.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

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604 Mission Street, San Francisco

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
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CONTENTS

Induction Generators

The induction generator is an inverted induction motor, of the squirrel cage type driven above synchronism. Though it has long lain dormant as a sort of scientific curiosity, an interesting example proving the general rule of the reversibility of dynamo-electric machinery, it has recently been resurrected to remedy some of the difficulties created by the tandem operation of synchronous generators on an alternating current system.

A crude conception of the conditions existing in such a system may be gained by comparing it with one of the 20-mule borax teams which an enterprising manufacturer has made familiar to us all. Let us assume that the mules are the generators and the wagons the load, which varies with the grade; let the speed of the team correspond to the voltage of the system and its pulling ability to the current; let the leading wattless current be represented by the activity of the leaders and the lagging wattless component by the inertness of the wheelers.

The freighter with his jerk line controls his leaders just as a governor adjusts the synchronous generator to load variations. These leaders are the most active animals in the team and stir up their more sluggish followers, especially the wheelers. Incidentally they would be just as well adapted to haul a light buggy as to be driven in tandem with a heavy team. Yet if they come to a sudden steep hill they are not good pullers but commence see-sawing back and forth and may lose the load entirely, while on the down grade they are likely to run away and wreck the outfit. They require some steadying and soothing influence, something that will pull harder on the up-grade and hold back on the down. This is provided by the wheelers who work well in tandem but are too slow and lazy to be driven alone, being mere machines giving power to the team but having nothing to do with its rate of travel.

By substituting synchronous generators for the leaders and induction generators for the wheelers we can get a mental picture of the functions of these two types of machines. The induction generator gives current only when connected to a system containing synchronous machines and it has no independent voltage. It merely feeds power into the system and does not participate in the voltage regulation. The synchronous generator gives almost unlimited current on a short circuit, corresponding to the leaders on a down grade, but the induction generator ceases to generate when short circuited. Synchronous generators supply both wattless and power current, while the induction machine supplies only power current.

Contrary to Mr. A. L. Allen's statement at the conclusion of his excellent paper, published elsewhere on this subject, the induction generator is fast becoming of industrial importance, the most notable installation being three 7500 kw. units already installed in the power plant of the Interborough Rapid Transit Company of New York City, to which other units of the same type are now being added. Without doubt it will be but a short time before similar machines are tried out on some of the Pacific Coast high tension systems.

PERSONALS.

W. G. Vincent Jr. is at Los Angeles.

W. S. Tevis of Bakersfield is at San Francisco.

Frank H. Short of Fresno, was at San Francisco last week.

C. L. Cory is at Modesto in connection with the rate for lighting question.

G. J. Kubrts, an electrical engineer of Los Angeles, was at San Francisco last week.

T. A. Work, the electric supply dealer of Monterey, was at San Francisco last week.

William Stanahan with the Coalingua light and power plant visited San Francisco this week.

E. V. D. Johnson, manager of the Northern California Power Company, is making an Eastern trip.

R. S. Buck, of the engineering staff of Sanderson & Porter has returned to San Francisco from the East.

George E. Church, who has electric power interests at Fresno, was a San Francisco visitor last week.

F. G. Baum, of F. G. Baum & Co., has returned to his San Francisco office after a trip to Santa Barbara.

Paul Shoup, assistant general manager of the Southern Pacific Company, in charge of electric lines, is at Los Angeles.

Cyrus Pierce of N. W. Halsey & Co., who are heavily interested in Pacific Coast electrical securities, is in New York City.

Thos. Morrin, consulting mechanical engineer, has returned to his San Francisco offices after a three months' vacation.

H. H. Hornby, manager of the conduit department of the Sprague Electric Company, is at the San Francisco branch office.

S. J. Lisberger has been elected chairman of the San Francisco Section of the American Institute of Electrical Engineers.

R. T. Brock of New York City is at San Francisco in the course of a Pacific Coast trip being largely devoted to power plant inspection.

Sidney Sprout returned to San Francisco last week after a trip to Oxnard in connection with some important engineering work in Ventura county.

W. F. Smith, general construction foreman of the electrical department of the Pacific Electric Railway of Los Angeles, motored to San Francisco during the past week.

Leon M. Hall, of Hall, Demarest & Co., returned last week from Red Bluff. He is doing the electrical engineering work for a new development in that section of the country.

J. C. Murray, sales engineer of the Kellogg Switchboard & Supply Company, has returned from a South American trip and will immediately take up his work in the telephone field.

B. C. Holst, who resigned last year as manager of the telephone sales department of the Western Electric Company at San Francisco to take up similar work with the Northern Electric & Manufacturing Company of Montreal and Winnipeg, is renewing old friends during a brief visit to the Pacific Coast.

George E. Pancoast, chief engineer of the Hearst News Service, recently arrived at San Francisco and has already closed contracts for several thousand dollars' worth of machinery, including a number of General Electric a.c. motors for installation in the new 12-story building that is to be occupied soon by the "Examiner" plant.

Calvin W. Rice of New York, secretary of the American Society of Mechanical Engineers, who has been touring the Coast, left Palo Alto for Los Angeles this week on his way East.

W. A. Hillebrand has been elected chairman of the papers committee of the San Francisco Section of the American Institute of Electrical Engineers, the other members being G. Deakin and A. H. Halloran.

J. G. De Remer has resigned his position with the Westinghouse Electric & Manufacturing Company at San Francisco to become assistant general manager of the United Light & Power Company with offices in the Mechanics' Institute Building, San Francisco.

A. Boissonnas, who is at the head of a number of electric power enterprises in Switzerland, has arrived at San Francisco from Geneva. He is making an inspection tour of the principal hydroelectric plants of this country, accompanied by E. B. Tracy, of W. P. Bonbright & Co., New York, bankers, interested in western electric power securities.

PACIFIC COAST JOBBERS' MEETING.

An enjoyable outing was held by the Pacific Coast Jobbers' Association at Catalina Island last week. Judging from the reports from those participating, the varied means of entertainment presented by this favored spot were much enjoyed.

Naturally the chief interest centered in the fishing for which this island is famed, prizes being offered for the largest fish caught with both light and heavy tackle. Mr. Albert H. Elliott caught a 62-pound shark with light tackle, thus earning a handsome humidor and Mrs. Thos. M. Debevoise was presented with a desk clock as a reward for her prowess in catching a 30-pound albicore with heavy tackle.

The golf honors were captured by Mr. F. B. Gleason, manager of the Western Electric Co., who won both the E. K. Patton and the regular Jobbers' cup. The meeting was concluded with a sumptuous golf dinner at the Hotel Metropole. Members and guests present included:

Mr. and Mrs. Thomas M. Debevoise, Mr. and Mrs. H. G. Aylsworth, Mr. and Mrs. George Cole, C. L. Gilson, R. D. Holabird, Thos. E. Burger, F. H. Poss, Joseph A. Herr, A. H. Elliot, F. B. Gleason, Franklin Overbagh, T. E. Bibbins, A. Carrigan, H. V. Carter, C. H. Carter, S. B. Gregory, C. R. Dederick, Ross Hartley, Frank Fowden, J. Schaufelberger, N. W. Graham, W. L. Goodwin, C. C. Hillis.

PACIFIC COAST MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

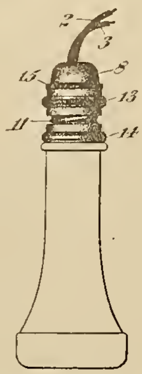
A meeting was held at the Palace Hotel October 14th, which was attended by Calvin W. Rice, secretary of the American Society of Mechanical Engineers, and a number of local engineers. The subject of organizing so as to hold meetings of the society at San Francisco was discussed after A. M. Hunt had been elected chairman. A resolution was adopted inviting the American Society of Mechanical Engineers to hold its semi-annual meeting at San Francisco at the time of the Panama-Pacific International Exposition in 1915. A. M. Hunt, W. F. Durand, E. C. Jones and Thomas Morrin will constitute the executive committee.

ILLUMINATING ENGINEERING COURSE AT JOHNS HOPKINS UNIVERSITY.

The course of Lectures on Illuminating Engineering, which is to be held at Johns Hopkins University October 26th to November 8th, under the joint auspices of the University and the Illuminating Engineering Society, is receiving a large amount of attention from the many electrical interests throughout the country. Many of the technical universities maintaining courses in electrical engineering are planning to send representatives to attend the course of lectures, in order to found complete undergraduate courses in those institutions.

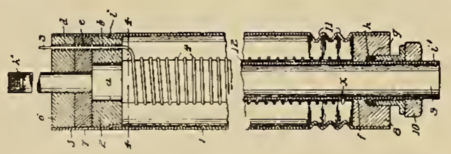
PATENTS

972,209. **Swiveling Attachment Device for Electrical Apparatus.** John H. Morley, Johnstown, Pa. An attachment device comprising a body portion carrying one set of wires, a plug carrying another set of wires, said plug being inserted



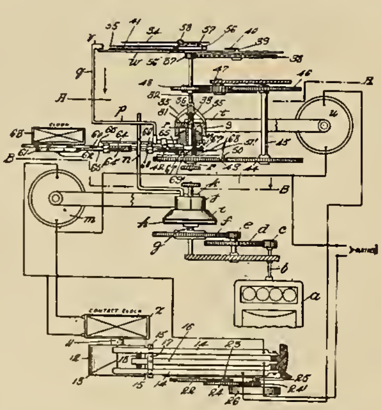
within the body portion and connected thereto by means of a spring on said plug, a sleeve insulated from said spring and loosely surrounding the sides of the plug to permit rotation, said s'eeve being in contact with the body portion, and a spring connecting the sleeve to one of the terminals.

972,308. **Electric Heater for Oil-Wells.** James E. Williamson, Pittsburg, Pa. In an electric heater for oil wells, the combination with the pumping tube, of a heater comprising an outer and an inner shell, and an electric resistance arranged upon the exterior of the inner shell, the said shell



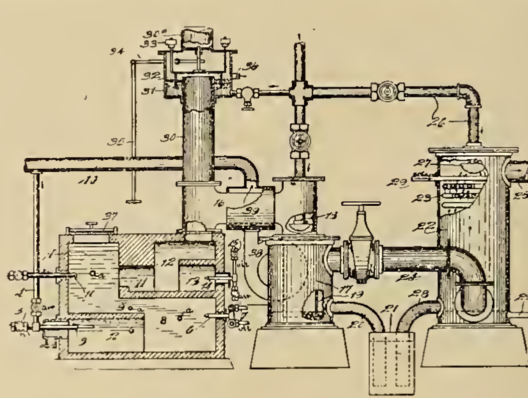
constituting the return conductor of said resistance, the said resistance being located in a water sealed chamber between said shells, the inner shell being adapted to be connected to said pumping tube, and the outer shell having a series of corrugations in the wall thereof.

972,538. **Maximum-Demand Meter.** Vladimir Karapetoff, Ithaca, N. Y. In a meter of the class described, the combination with a wattmeter and means for indicating the maximum power demand during a given interval of time, of a two-part clutch which operatively connects said wattmeter



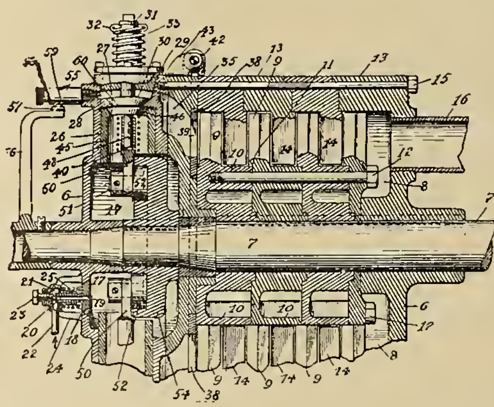
and means; an armature formed with ears and attached to one of the parts of said clutch; and electromagnetic devices for raising and turning said armature to release said clutch and restore said means to their initial position, said ears insuring that the final position of said means will be accurately at their zero.

972,486. **Continuous-Make Gas Apparatus.** Elmer E. Wickersham, Watsonville, Cal. The combination in a gas apparatus, of a mixing chamber, a combustion chamber below the mixing chamber having an arch separating it from said mixing chamber, a burner in the combustion chamber, a chamber in the rear of the combustion chamber and connecting



with a space above said arch, the combustion and mixing chambers opening into the rear chamber, and an atomizer with an oil and air supply connection, said atomizer discharging in the rear chamber and approximately in line with the mixing chamber and above the combustion chamber burner.

972,642. **Gas-Turbine Engine.** William A. Reed, Hollywood, Cal. In a gas turbine a plurality of radially arranged compression chambers, each chamber having a piston therein; a driving shaft; means secured to said shaft to operate said piston; valves in the ends of said pistons; a feeding chamber in communication with said compression chambers; radially arranged explosion chambers in com-



munication with the outer ends of said compression chambers; valves in said last communication; a vane chamber having an exhaust port; direction changing chambers having ports opening into the vane chamber; means to control said last mentioned ports; rotary vanes within the vane chamber secured to and projecting radially from the driving shaft, and radially arranged deflecting vanes secured to the vane chamber casing, and projecting toward the shaft, said deflecting vanes alternating with the rotating vanes.

BOOK REVIEWS

Solenoids, Electro Magnets and Electro Magnetic Windings. By Charles R. Underhill, 342 pages, 5x7½; 223 illustrations. D. Van Nostrand Co., New York and Technical Book Shop, San Francisco. Price, $2.00.

This treatise brings into compact form a wealth of valuable information on electro magnets, which govern almost all electrical apparatus. The introductory chapters are devoted to definitions, units and calculations of simple electric and magnetic circuits. The following chapters define the solenoid and give theoretical and practical characteristics of air-return and iron-clad types both with and without armatures. Subsequent chapters are devoted to alternating current electro magnets. The concluding chapters deal with practical designing and construction, including insulation, winding and heating for regular and special types. The last chapter is a compilation of tables and charts for convenient reference. The book is well written and contains much valuable data.

Standard Handbook for Electrical Engineers. 1500 pages; 4x7, leather bound. McGraw-Hill Book Co., New York and Technical Book Shop, San Francisco. Price, $4.00.

This is the third edition and 19th thousand of this book which has become a standard in fact as well as in name within less than three years. Its contents are so well known as to require no exhaustive summary at this time. It is divided into twenty sections, each section written by an expert and thumb indexed for convenient reference. Many of these sections have been entirely rewritten in accordance with the dictates of recent practice, all of them have been corrected and most of them have been enlarged. This edition has 200 pages more than its predecessors. It is invaluable to every electrical engineer.

Power Gas and the Gas Producer. By J. C. Miller; illustrated; 184 pages, 5x8. Popular Mechanics Co., Chicago; Technical Book Shop, San Francisco. Price, $1.00.

This text is an endeavor to give a popular explanation of the theory and practice of producer gas, written for the layman. This necessitates the elimination of all chemical and mathematical formulae and the substitution of generalities for specific data. It is divided into eleven chapters and is first concerned with the properties of various kinds of producer gas including their composition, heat values and their physical characteristics. Brief descriptions of several styles of producers are illustrated by both text and pictures and a critical discussion given of the fuels best adapted for use in producers. One chapter is devoted to the practical operation of the gas producer and concluding sections contain detailed comparison of gas power and steam, including their reliability, convenience and cost. A matter of practical interest to Pacific Coast readers namely oil gas producer gas receives no mention whatever. While the book is of little value to the engineer it gives an excellent introduction for more advanced study on the part of the beginner.

Electric Motors. By Francis B. Crocker and Morton Arendt; 291 pages, 6x9; 158 illustrations. D. Van Nostrand, New York City, and Technical Book Shop, San Francisco. Price, $2.50.

This is essentially a college text book, being an outgrowth of a course of lectures on electric motors and their application given at Columbia University. The subject is so clearly and logically presented and with such accurate detail that it will likewise prove of value to anyone operating electric motors. After a brief historical introduction, the authors give a general discussion of the different types of direct current motors and summarize the advantages of electric drive. This is followed by chapters devoted respectively to direct current shunt, series and compound motors, the theory of the machine being developed co-ordinately with the practice. In each case there is given test data and full analysis of the effect of varying cnnditions, together with exhaustive treatment upon the different methods of speed control. Following this is a brief classification and history of alternating current motors which are subsequently treated in more detail under the headings of synchronous motors, induction motors and commutating alternating current motors. While in no sense a popular treatise, techincal problems are so carefully explained as to be capable of solution after a little study.

The History of the Telephone. By Herbert N. Casson; 315 pages, 5x8, well illustrated. A. C. McClurg & Co., Chicago; Technical Book Shop, San Francisco. Price,

An occasional dip from the stern realities of engineering into the romance of its development is refreshing and inspiring. In a happy intermingling of history and biography, Mr. Casson tells the story of the telephone. It is as interesting as a novel and has the added charm of facts. In his skillful handling of words, however, it must not be forgotten that the author tells but half the story, for this book would better be entitled "The History of the Bell Telephone." So while this narrative is read and enjoyed it should be with the knowledge that there are other chapters equally interesting which have been omitted. The history of the Civil War writter with the bias of a Northerner may give just offense to a Southerner. In fullness of time therefore we look for a like history of the Independent telephone which will also reflect due credit as does this book to those who have developed the wonderful Bell system.

WASHINGTON WATER POWER DEVELOPMENT.

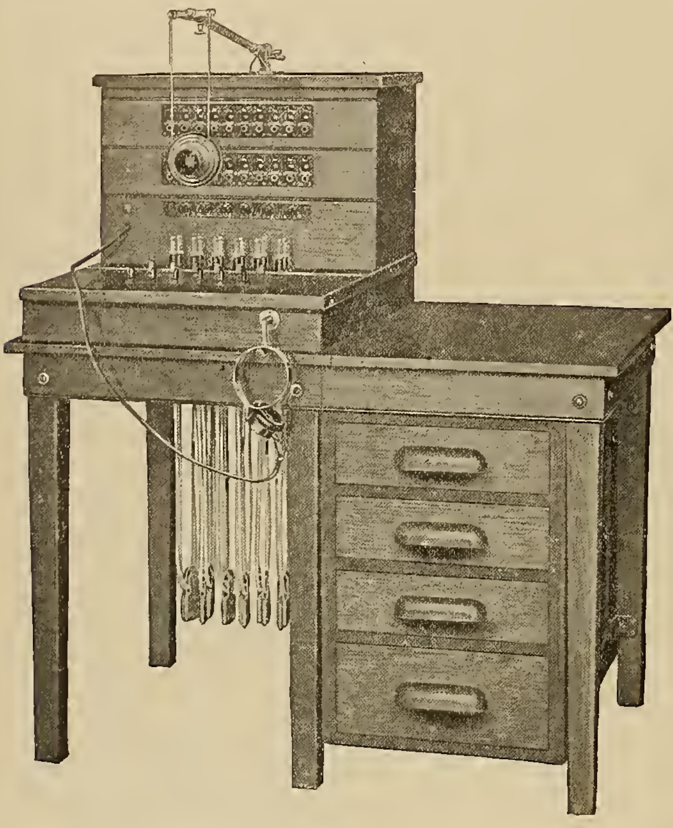
SPOKANE, WASH.—The Washington Water Power Company, controlled largely by New York and Boston capital, has acquired 7000 acres of lands, including power sites on both sides of the Spokane river in Spokane and Stevens counties, north of Spokane, for $700,000 and it is given out by D. L. Huntington, president of the corporation, that other acreage will be bought, preparatory to expending $1,000,000 in power development work. The company now has sufficient holdings to back water over a strip of 20 miles in length, thus providing one of the largest reservoirs on the Spokane river. The deal for the Big Bend Water Power Company's lands and rights, involving about 400 acres, was consummated last week at a figure said to be $250,000. The officers of the Big Bend Water Power Company are: President, B. F. O'Neill, Wallace, Idaho; vice-president and general manager, E P. Spalding; secretary and treasurer, Mrs. A. M. P. Spalding. It is on this sité that a gigantic dam will be built for backing the water over the large area. From the Spaldiug site alone it is estimated that between 75,000 and 80,000 horsepower can be developed. It will call for a dam 150 feet in height, connecting perpendicular granite walls 300 feet from base to cap. The company already has started several crews of men at work. The site bought from H. L. Moody of Spokane and his associates is four miles above the Lapray bridge, one of the landmarks of the Northwest. This site is purchased for the riparian rights solely. The bridge will be inundated in the present plan of development about 40 feet. This will necessitate the moving of the crossing to another point. The large increase in the company's bond issue, from $10,000,000 to $15,000,000, last year, figures in the new project, and it was this which brought several of the large stockholders from the east to Spokane a few months ago. The company started work in September on a tunnel in the Spokane river near its plant in Spokane, but abandoned this work recently.

MARTINEZ, CAL.—Work on the grading of the right of way for the Oakland and Antioch Railway, between Bay Point and Lafayette, has been resumed by the Bay Point Construction Company in order to finish the work left incomplete by Hard & Co., which was temporarily engaged to do part of the work. Seventy-five men will be set to work to complete the line before the winter season.

INDUSTRIAL

AN INNOVATION IN SMALL SWITCHBOARD CONSTRUCTION.

A novel type of small switchboard capable of being not only easily increased in capacity but at the same time readily convertible to suit various service conditions is being marketed by the Western Electric Company. The telephone company that operates a small exchange is confronted with the problem of selecting a switchboard of the proper style and capacity that will meet their service conditions at the present time as well as in the future. This problem has



1800 Desk Type equipped with Suspended Transmitter and Head Receiver and 20 lines. Uses Combined Jack and Signal.

been all the more perplexing when the telephone company is unable to determine with any degree of accuracy what their future requirements might be. Thus they have often found it necessary to either purchase a switchboard that might serve for only a short time and then discard it or they might find at a later date that they had purchased a switchboard of such a large size that they would never be able to make full use of it.

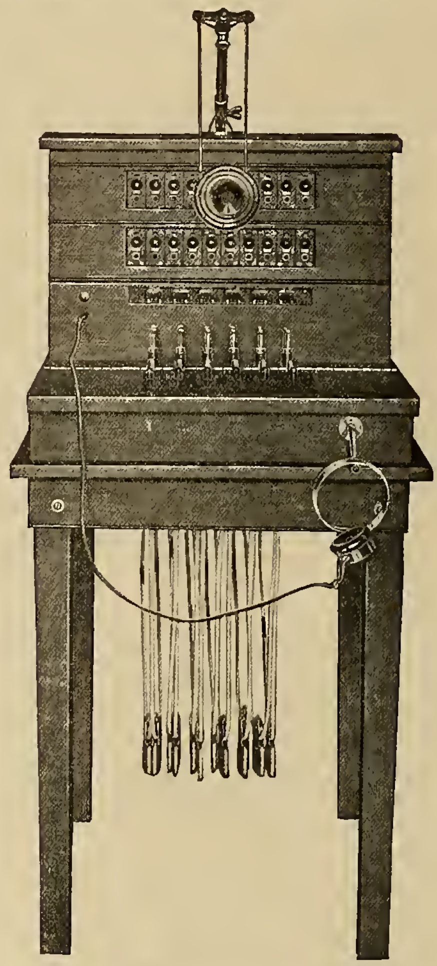
This and other problems have been very cleverly solved by the Western Electric Company with the design of their new No. 1800 unit type switchboard. It will be noted from the illustrations that this switchboard is built up of several separate parts, comprising top units, line units, cord units and supporting units.

As the telephone company's requirements increase so can the switchboard capacity be increased and at all times the telephone company has a minimum investment.

The top units can be supplied with either a hand telephone set or a suspended transmitter.

The line units can be supplied with either self-restored jacks and signals, manually restored drops and jacks, ringers, through toll line apparatus, etc.

The cord units can be supplied with either listening jacks and supervisory drops or ringing and listening keys and supervisory drops. They can further be furnished with the single supervision, single supervision, non-hang-up or single supervision, non-ring-through, non-hang-up. The supporting units



1800 Floor Type equipped with Suspended Transmitter and Head Receiver and 20 lines. Uses Combined Jack and Signal.

can be supplied for wall type of switchboard, for floor type or for desk type.

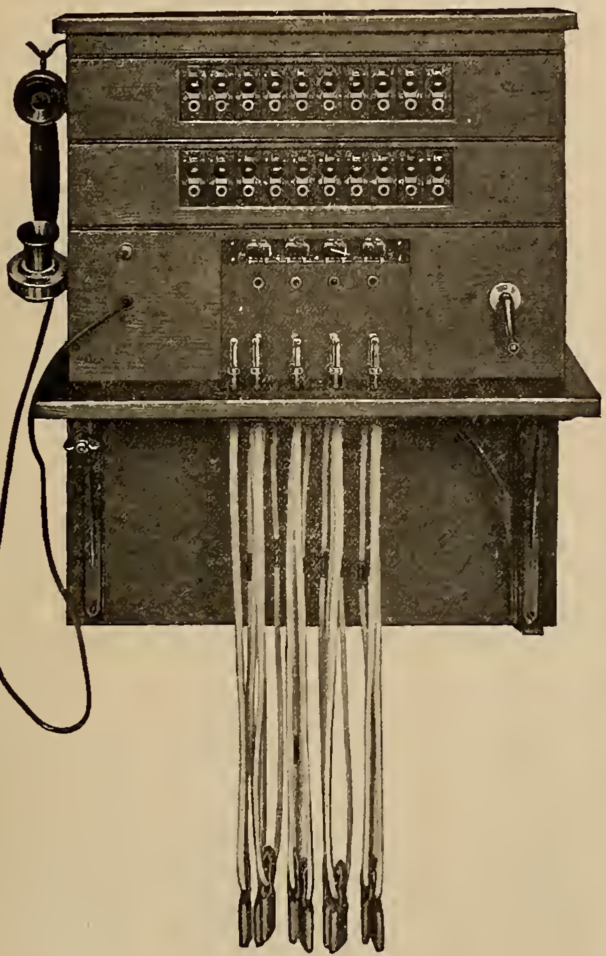
Many small switchboards are situated in business places or private homes, where the operator has other duties to perform. Under such conditions a wall type, equipped with a hand telephone set is found the most desirable.

As the telephone company's business increases the operator may be required to be seated at the switchboard the greater part of the time and, therefore, a floor or desk type of switchboard having a suspended transmitter is quite essential. With the sectional unit scheme, a switchboard cannot only be increased in capacity but it also can readily be converted to any desired type.

There are many hundreds of switchboards that are capable of giving several years of good service that are stored away because the telephone companies have no further use for them since they no longer fit in with the new order of things. Such switchboards are unquestionably a bad investment because the telephone company did not realize the full value from them. On the other hand, this new unit type of switchboard would be a good investment, since on account

of its elasticity a place of service could always be found either in the whole of in part.

All of these units are especially designed so that they can be assembled and installed with unskilled help. Screw-type of terminals are provided for all of the line wire connections. All electrical connections between units are auto-



1800 Wall Type Equipped with Hand Set and 20 lines: and using Combined Jack and Signal.

matically made by means of the machine screws that hold the various units together, thus it is impossible to connect them up wrongly. This series includes 30 different units, which enables the telephone company to meet every legitimate condition.

ELECTROLYTIC LIGHTNING ARRESTERS.

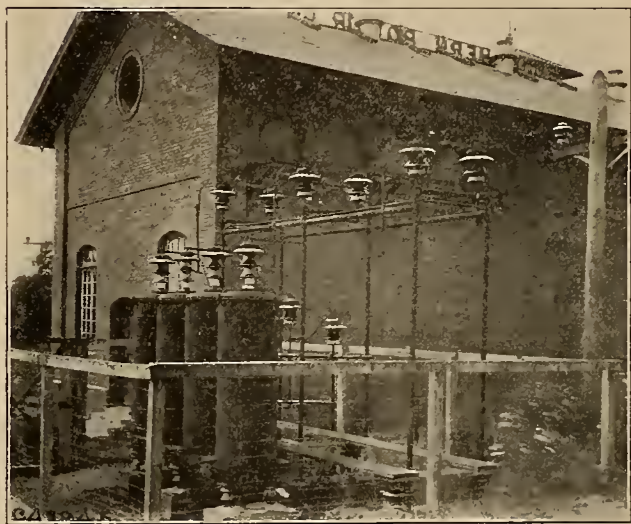
Many devices have been placed upon the market for the protection of electric equipment from abnormal voltage on the line, due to lightning or any other cause, one of the most effective pieces of apparatus devised for this purpose being that type of lightning arrester which depends upon the safty-valve action of a film on an aluminum plate. This type is commonly known as the electrolytic arrester and, in practice, consists of nested aluminum trays filled with electrolyte and submerged in oil.

The electrolytic lightning arrester has ideal characteristics and closely resembles in action a relief or safety valve, which it truly is for the electric system. The horn gaps which are between the arresters and the line break down on over voltage, and if this voltage amounts to over approximately 330 volts per tray, a free passage through the film from tray to tray and thence to the ground is provided. When the voltage drops to normal, which is below the critical voltage of the tray, the apparent resistance of the film reasserts itself and the flow of the current is cut down so tbat the horn gaps disrupt the arc and all further flow of current ceases.

The nested trays are placed in oil-filled, welded steel tanks, which for 22,000 volts and above are built with cast covers and outdoor terminals, so that the entire arrester can be placed outdoors. The complete arrester consists of four tanks mounted on an insulated platform for ungrounded neutral service, and three tanks grounded for grounded neutral service. For 13,200 volts and under, the arrester is arranged for indoor service only, as the horn gap setting is so small that much more effective service is obtained when the arrester is housed. For the lower voltages the general arrangement of tray is the same, but a smaller number of tanks is used.

Since, when the electrolytic type of arrester is allowed to stand without current passing through it, the film on the plates dissolves, it is necessary to periodically pass current through the arrester in order to keep the film in the best condition. This prevents an abnormal rush of current when the arrester discharges after a long period of idleness.

The rate of dissolution of the film depends upon the kind or electrolyte used and the temperature. There are two kinds of electrolyte made by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., one of which requires that the



Electrolytic Lightning Arresters

horns be bridged daily to pass current through the arresters, and the other which requires that the horns be bridged only every seventh day. The latter electrolyte has been known to stand without current for very long periods during cold weather, and when the horns were bridged no undue rush of current followed. However, in order to keep the films well built up, it is recommended that current be passed through this electrolyte every seventh day; this offers no inconvenience, as apparatus in general should be inspected at least this often.

When arresters are bridged at normal voltage, a bluish, crackling static arc indicates the normal condition of the arrester. If the arc is reddish and fluffy, and rises high on the horns, it is evident that the bridging of the horns has been deferred too long a time, and it will take a short period before the arc comes down to normal.

The horn gaps and bridging device are mounted on a two-inch pipe frame, to which is also attached the transfer switch used for interchanging a ground and phase tank on ungrounded neutral arresters. The bridging device is very simple and can be operated from either end.

As the voltage increase the number of trays in the arrester also increases. Hence, for a higher voltage, if the trays were all built in a continuous structure, it would be awkward to handle and require considerable overhead room when installed indoors. For this reason, on all arresters above 13,200 volts, the Westinghouse tray structure is built

up into sections containing not over 50 trays, which slide into place, one above the other, between guides supported by a base casting fitting closely the bottom of the tank. Each section when filled with electrolyte can be easily handled without danger of upsetting it. The electrolyte is poured into the trays by means of a measuring cup, which contains the correct amount of liquid for each tray. When a section of trays is filled the electrolyte is plainly visible so that each tray can be checked.

All parts of the supporting frame directly in contact with the trays are made of the best grade of porcelain; hence, any danger due to burning supports, which is likely to be present in case wood is used, is entirely eliminated.

If, when the horn gaps are set to get the maximum protection from the arrester, a ground on one phase occurs, the horn gaps connected to the other phases will discharge until the line is cleared, or is thus subjected to a continuous discharge that may last a long time, the Westinghouse arresters are designed with large tanks holding sufficient oil to absorb the heat of a continuous discharge lasting over a considerable period.

The tanks are built large on the diameter so that the clearance between the top tray and tank where the maximum voltage exists provides a good insulation factor of safety.

NEW PACIFIC COAST REPRESENTATION FOR EASTERN MANUFACTURERS.

The Machinery & Supply Company, with offices at 61 Fremont street, San Francisco, have been appointed Pacific Coast representatives of a number of prominent Eastern manufacturers of power and mining machinery. A large stock for Pacific Coast buyers will be carried at the new Class A concrete warehouse being erected near Second and Bryant streets to facilitate quick delivery. Sales offices are also to be established in Los Angeles and Seattle.

This stock includes a complete line of heavy duty induction motors from the Ideal Electric & Mfg. Company of Mansfield, Ohio, power and filter presses from Wm. R. Perrin & Co., of Chicago, Ill., and Dick and Church boilers from the Phoenix Iron Works Co., of Meadville, Pa.

The Machinery & Supply Co., have been appointed exclusive Pacific Coast distributing agents for the Pittsburg Transformer Company and will carry a complete stock of this well known product. They are also agents for the oil furnaces, both metallurgical and forging, manufactured by the W. S. Rockwell Co. of New York City and for the electric meters manufactured by the Columbia Meter Co. of Indianapolis, Ind. Their representations further includes a complete line of "Solar" incandescent lamps.

The personnel of this new company includes Mr. R. B. Elder, formerly manager of the San Francisco office of the Allis-Chalmers Co., who has been appointed sales manager, and Mr. H. C. Wybro, formerly president of the Wybro Hendy Co., who will act as president. Connected with the staff also, are Mr. W. N. Dean, who has charge of the filter press department; Mr. A. E. Mason, formerly in charge of the furnaces and forge department of the Allis-Chalmers Co. at Milwaukee, Wis., who will handle the Rockwell line and Mr. George Boerschardt of the lamp department.

The entrance of this new firm into the industrial power field marks the welcome introduction of a number of Eastern manufacturers into the Pacific Coast market.

NEW CATOLOGUES.

Bulletin No. 431 from the Triumph Electric Company illustrates and describes Triumph alternating current generators.

Bulletin No. 1121 from the Fort Wayne Electric Works illustrates and describes the "Northern" type B direct current generators.

Bulletin No. 126 from The Electric Storage Battery Co. gives the details of a new type of oil insulator for supporting "Cloride Accumulator" cells in high voltage service.

The October number of The J.-M. Packing Expert from H. W. Johns-Manville Co. contains some excellent suggestions on boiler feed pump packing in addition to other interesting facts about J.-M. Packings.

Bulletin No. 10 from the Duncan Electric Company is devoted to the Duncan portable test watthour meter, containing a well illustrated and well written description of the operation and uses of this rotary standard.

Bulletin No. 125 from the Electric Storage Battery Company consists of a description of the installations of the "Chloride Accumulator" on the system of the Gulf Port and Mississippi Coast Traction Company.

Vitrified Fire Clay Conduit as manufactured by the Fire Clay Product Company of Brazil, Indiana, with offices in the Stock Exchange Building, Chicago, is well catalogued in a valuable pamphlet recently issued by the company.

Bulletin No. 1125 from the Fort Wayne Electric Works is devoted to the type K.3 Single Phase Induction Watthour Meter. Instruction book No. 3043 gives detailed directions regarding its installation, adjustment and connections.

Holophane Illumination for September, 1910, from the Holophane Company, illustrates and describes a new line of Holophane glass for residence lighting and contains some valuable hints upon the illumination of pictures, study rooms and drafting rooms.

Automatic Regulating Apparatus designed and manufactured by The Electric Storage Battery Co. is illustrated and described in their Bulletin No. 127. This includes the carbon regulator, adapted for controlling either a.c. or d.c. load fluctuation, and the recently developed average adjuster and current stop.

Portable Watthour Meter Calibrator, type K-M3, for alternating current, is illustrated by half tones and described by text, in Bulletin No. 1124 from the Fort Wayne Electric Works. This instrument eliminates the use of the stopwatch and allows of meter test under varying load from all ranges of service from light to full load.

The Engineering Department of the National Electric Lamp Association has just issued two Bulletins—one entitled "Mazda Multiple Lamps" (Bulletin 13) and the other "Hylo-Economical Turn-Down Electric Lamps" (Bulletin 14). Bulletin 13 contains practical information and technical data on Mazda Multiple Lamps for use on 100-125 volts and 200-250 volts. Bulletin 14 describes the turn-down lamp. The principle on which these lamps operate is fully explained and illustrated by means of diagrams.

TRADE NOTE

The General Electric Company will furnish to the Ray Consolidated Copper Company of Kelvin, Ariz., complete switchboard apparatus for the generating station, mill sub-station and mine sub-station. There will be 14 panels in the generating station to control four 2200 k.v.a. 6600 volt generators with five feeders—one for the station auxiliary, two for the mill substation, one for the pump station and one for the transformers to step up to 44,000 volts, for the mine sub-station, 20 miles away. In each of the sub-stations there will be a 10 panel board to control transformers stepping down from 6600 to 460 volts in the mill station and from 44,000 to 460 volts in the mine substation. The boards in each station are to control feeder circuits for induction motors; K-12 and K-6 hand operated oil switches will be used on 6600 and 44,000 volt circuits and K-2 switches will be used on 460 volt circuits.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—The Raymond Telephone Company of Bear Lake county, capital $10,000, has been incorporated by Thos. M. Mumford and Geo. H. Hall.

HIGHLAND, CAL.—The Cleghorn Water Company has been incorporated by J. M. and L. D. Cleghorn and J. E. Williams with a capital stock of $20,000.

BILLINGS, MONT.—The Billings Traction Company, capital $100,000, has been incorporated by C. J. Eddy, J. W. Patterson and J. A. Connolly, all of Muskogee, Okla.

OROFINO, IDAHO.—The Orofino Electric Company, capital $25,000, has been incorporated to handle electric power plants and engage in manufacturing; incorporators are K. G. Osterhout, Theora Lister, J. H. Lister.

FINANCIAL

VALE, ORE.—The Council has passed an ordinance providing for holding an election to vote on issuing bonds in the sum of $35,000 to be used in installing a complete water system for the city.

OCEANSIDE, CAL.—It is expected that the $30,000 issue of 5 per cent bonds for the improvement of the municipal water plant soon to be put on the market, will bring a fair premium. The bonds will run 40 years and will be of $500 each.

SALEM, ORE.—The initial step toward the floating of bonds in the sum of $400,000 for the purchase of the plant of the Salem Water Company has been taken by the City Council. An ordinance calling an election will come up for final reading at the next council meeting.

VANCOUVER, WASH.—A special election is to be held on the 6th of December in the city of Vancouver, Clarke county, Wash., at which election shall be submitted the question as to whether or not the city shall borrow money in the sum of $314,000 to be used in furnishing and constructing a water system.

HELENA, MONT.—Plans and specifications for the new municipal water plant, submitted by City Engineer C. W. Halmick, have been adopted by the city council, and an election will be held January 10 to vote on the issuance of bonds in the sum of $650,000, bearing five per cent interest, for the purpose of installation of such system.

SAN FRANCISCO, CAL.—Bonds of the Los Angeles Railway Company will be redeemed with $142,378.58 now in the sinking fund of the company for that purpose, and bids are invited on or before November 10 for the surrender to this company of the 5 per cent mortgage bonds of the Los Angeles Railway Company to the extent of $142,378.58, at prices to be named by the bidders, but not to include a premium of more than 5 per cent on the par value of the bonds offered. All bids should be directed to I. W. Hellman, treasurer of the Los Angeles Railway Company, at his office in the Wells Fargo Nevada National Bank, San Francisco, and should state the lowest price which will be accepted for such bonds.

TRANSMISSION.

OROVILLE, CAL.—With the settlement of the suit brought by the Great Western Power Company against the various estates in this county, the power company has practically completed its rights of way for its second tower line of high tension wires from this city to Oakland. The company has been quietly engaged for the past year in buying rights of way for its double tower line.

PASADENA, CAL.—Pasadena is planning to build an extension at the municipal electric power house to accommodate the additional boiler soon to be installed and to make room for future extensions.

SEATTLE, WASH.—An auxiliary city power plant to be located on Lake Union will be built next year. It will be operated by water power and will supply 2000 additional h.p. to the city. A reservoir of about 200,000 cubic feet capacity will be built.

CARSON CITY, NEV.—The Brunswick mill site and power site, with water rights, has been taken over by the Western Smelters Corporation. A large reservoir will be built and a power plant built to supply power to the new smelter.

CENTRALIA, WASH.—It is announced that the Twin City Light & Traction Company has succeeded in raising $150,000 with which to build its proposed power plant. This company may lose its franchise here and the city may install a municipal lighting plant.

OROVILLE, WASH.—The North Washington Power & Reduction Company of Republic is circulating a petition through its local manager, asking that the city grant a franchise for the construction and maintenance of power and telephone lines within the city limits.

SPOKANE, WASH.—Walter Hovey Hill, consulting engineer for the United Placer Mines Co., which owns diggings at Lucile, 40 miles from Grangeville, Idaho, states that the company is planning on the installation of a hydroelectric plant with a capacity of 5000 horsepower.

MODESTO, CAL.—The Sierra and San Francisco Power Company is securing rights of way from the main power line at a point on the J. F. Miller land near Atlanta south through Ripon, Salida and southward toward Modesto. It is the plan of the company to reduce from 100,000 to 15,000 volts and carry the power southward on a pole line. There will be a line from the reducing station westward to the town of Menteca.

SEATTLE, Wash.—D. W. Ross, city electrical engineer, has designed plans for the proposed $60,000 2000-horsepower city auxiliary power plant to be located on Lake Union, which will be operated by water power. Construction work is to start early in the year. A 200,000 feet capacity reservoir will be built adjoining the present reservoir at Volunteer park, and a gravity system will be established from the reservoir to Lake Union to furnish the necessary waterpower for the proposed plant.

LOS ANGELES, CAL.—An opening wedge into the discussion of the electric power problem of the Owens river aqueduct has been furnished by the Board of Public Works' announcement that it has agreed on behalf of the city of Los Angeles to supply the town of Independence, Inyo county, with aqueduct power. The dam is used to hold back the waters for the generation of power at the plant, which is one of the largest in the world. At the time the Western Pacific raised the levee system along Front street a track was laid on top of the levee and this gives the best transportation facilities from the plant.

SPOKANE, WASH.—Following the outcome of the litigation respecting the overflowed lands just below Coeur d'Alene, Idaho, where the Washington Water Power Company has its chief plant, the management is now planning a magnificent powerhouse at Nine-Mile Point. Extensive acreage has been bought up recently in the neighborhood, so that there

will be no likelihood of future damage suits ensuent upon the building of the necessary dam across the river. There is already a plant belonging to the Spokane & Inland Empire system at the same place, but the growing demands for power attendant upon the entry of new manufactures into the city, it is anticipated, will presently absorb an even greater extension of generated power than is at present contemplated.

SAN FRANCISCO, CAL.—U. S. Commissioner Harry M. Wright has recommended that the temporary injunction granted by the U. S. Circuit Court prohibiting the Hydro-electric Company from proceeding with the building of a pipe line across the Mono forest reserve be sustained.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Water Company is making preparations to more than double its power at the Moore plant. An additional water wheel will be put in and still another in the spring. The plant will have 10,000 horsepower. The company will also do away with the wooden flume to the power wheel and will substitute iron pipe from the ditch to the plant.

TRANSPORTATION.

BELLINGHAM, WASH.—A survey is being made for a tram line from Senator Polson's mines to the B. B. & B. C. terminus.

PORTLAND, ORE.—Plans are under way to electrify the Southern Pacific line on the west side from Portland to Corvallis.

BELLINGHAM, WASH.—It is reported that arrangements have been made for building the Nooksack Valley Traction Company line from this place to Sumas.

SPOKANE, WASH.—The Spokane Traction Company will probably begin construction work on the extension of the N. Howard and Lincoln Heights lines respectively.

LOS ANGELES, CAL.—The City Council has passed an ordinance consenting to and accepting abandonment of a portion of a certain street railroad franchise granted to Wesley Clark on Park View street.

LOS ANGELES, CAL.—Property owners on Jefferson street between Main street and Central avenue have asked the Council to grant the Los Angeles Street Railway Company a franchise for a street railway on that portion of Jefferson street.

LOS ANGELES, CAL.—A petition is on file with the City Clerk asking the Council to advertise a franchise for sale through Broadway tunnel, so that Highland Park cars may reach Broadway, reducing the running schedule. The Los Angeles railway is willing to build the line if the franchise is offered for sale.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will build another club house for the use of linemen on the block at Hawthorne, Clay, Water and First streets. The building will be 100 by 200 feet, reinforced concrete, and will be used in part by the lighting department of the company.

VISALIA, CAL.—The Visalia Electric road has started work on the branch to Woodlake, and it will be finished by November. The branch, starting from the Bravo Lake station, will be three miles in length and will reach into the heart of the rich orange lands of that vicinity. The grading contract has been awarded to Buckman & Sons of this city.

ILLUMINATION.

OLYMPIA, WASH.—The Olympia Gas Company has authorized an issue of $1,000,000 in bonds for the purpose of enlarging its plant.

REDWOOD CITY, CAL.—The Redwood Gas & Electric Company has been granted permission to place gas mains in Hopkins avenue from Hudson to Cedar streets, Dingee Park.

FARMINGTON, N. M.—The Electric light plant has been purchased by a company headed by R. W. Kowles. They have signed a contract for enlargement and use of the Star ditch and will spend about $100,000 in improvements.

EUGENE, ORE.—Blue print plans for proposed changes to take place at the Springfield electric light plant this winter have been received by the Northwestern Corporation. The plant will be elarged to double its present size and a substation will be built. The increased plant will contain the new 2000 kilowatt turbine generator and two additional boilers with a capacity of 500 kw. each. The construction will soon begin. Machinery will arrive in January.

WATERWORKS.

TRACY, CAL.—A. T. Ames of Niles has been requested to furnish an estimate of cost of establishing a municipal water system here.

FULLERTON, CAL.—The Fullerton Domestic Water Company has been purchased by Tarber Montgomery. The new owner will make extensive improvements to the plant and mains.

LOS ANGELES, CAL.—A complete irrigation system of high pressure steel pipes, about 5 miles in length, equipped with one of the most econonmical and modern pumping plants is being built by Emil Firth in the Orange Cove tract.

LOS ANGELES, CAL.—T. S. Van Dyke is preparing to install a system of waterworks at Del Mar, for a syndicate of wealthy Los Angeles men which plans to make Del Mar one of the fashionable resorts of southern California.

LONG BEACH, CAL.—Initial steps have been taken by the City Council towards the installation of a high pressure water system in the business district for protection against fire. The estimated cost of this system is $113,080.88.

SAN FRANCISCO, CAL.—Sealed bids, in triplicate will be received until 11 a. m., October 28, at the office of the Constructing Quartermaster, Fort Mason, Cal., for furnishing and laying an 8-inch water supply main from the dock to the tanks at Ft. Baker, Cal.

MORGAN HILL, CAL.—Claiming that the water rates as set by the Board of Trustees of the town of Morgan Hill, Santa Clara county, are insufficient to pay the cost of operating its system, the Morgan Hill Water Company began suit in the U. S. Circuit Court Saturday to enjoin the Trustees from putting the rates into effect.

PORTLAND, ORE.—The Northwestern Engineering Corporation has prepared plans for a gravity pipe irrigating system for the town of Pasco, water to be supplied by the Pasco Reclamation Company from its plant on the Snake river. The town will also be supplied with a complete sewer system. The estimated cost of the improvements is $100,000.

SAN FRANCISCO, CAL.—Assistant U. S. Attorney Thos. E. Haven has completed his argument in the Spring Valley Water Company's water-rate case before U. S. District Judge E. S. Farrington. The counsel took the ground that the expenses of the water company's litigation with the city were not properly chargeable in the rates, and in support of his contention quoted from the decision of the California Supreme Court in the San Diego water cases, in which the expenses of the water company were decided not to be chargeable to the rates.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 18 | SAN FRANCISCO, OCTOBER 29, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXV SAN FRANCISCO, OCTOBER 29, 1910. NUMBER 18

THE DENVER ELECTRIC SHOW

The first annual electric show at Denver, held under the auspices of the Colorado Electric Club, was brought to a brilliant and successful culmination on Saturday night, October 15th. That it was likewise financially profitable is due not only to the enthusiastic support given by the people of Colorado but also to the untiring efforts of the directors. The personnel of the board was H. L. Woolfenden, president; F. W. Frueauff, first vice-president; J. B. Griffith, second vice-president; C. F. Oehlmann, secretary and treasurer; Alvin R. Hall, George A. Woolley, W. G. Matthews, Walter F. Brown, W. P. Carstarphen Jr., John M. Connelly and B. S. Manuel.

Besides the brilliant interior illumination from ten thousand incandescent lamps and flaming arcs, the exterior of the auditorium as well as the surrounding streets were a blaze of light, 25,000 additional street lamps having been used to give a portiere effect.

General View of Denver Electric Show.

The most notable lighting feature of the show was the beautiful sunrise effect showing a typical Rocky Mountain landscape with a running stream. Four times each day all other lights were extinguished to display this to the best advantage. The brilliant coloring of a Colorado dawn preceded the gradual appearance of the rising sun, an eight-foot disc studded with twenty-five hundred lamps and uniformly regulated by

Chamber of Wonders.

a system of clock-work to give a most realistic effect. A number of flashers gave the effect of moving water in the mountain stream.

Much popular attention was attracted by the Chamber of Wonders in the basement; a large room draped in somber colors, in which was displayed the modern wonders of electricity, principal among these being a specially designed apparatus for producing high voltages at high frequencies; this apparatus consisting of an oil immersed transformer with a primary winding, taking 440 volts a.c., 60-cycle current, the secondary giving 150,000 volts, this current being connected to the primary of a Tesla coil through large 40-plate glass condensers, and multiple spark gap oscillator, which produced at the secondary terminals of the Tesla upwards of one million volts, at high frequency.

The exhibit showed the disruptive power, through the piercing of glass plates, brush discharge, climbing arc, illuminating of Geissler tubes and vacuum electrodes, imitation thunder and lightning, passing of the million volts through the body of the experimenter, and lighting incandescent lamps held in his hand, and various other beautiful and spectacular demonstrations.

There was also exhibited in this room an electric water forge, in which bars of iron were heated red hot by immersing in a tank of cold water; the telautograph, an instrument whereby writing, drawings, etc., will transmit to any distance over wires by electricity; a singing arc; the Thompson electro magnetic experiments, which include lighting of incandescent globes immersed in water without wire connections, leaping rings and discs and many other wonderful and beautiful demonstrations of the electro-magnetic field; wireless telegraph, wireless telephones and other modern applications of electricity. A complete meter testing exhibit showed the operation of all kinds of devices used for measuring current.

Allis-Chalmers Co. exhibited Bullock electric generators, transformers and motors.

American District Telegraph Co. showed their patent noninterfering watchman box in operation and a self-adjusting relay patented by W. W. Alexander. They also showed the old style watchman system.

American Multigraph Sales Co. exhibited one of their electric-driven printing machines and also one of their folding machines. A bulletin was printed here of the different events that took place during the day.

American Steel & Wire Co. showed a large assortment of different sizes of wire and cable.

Barker Cuisinette Co. showed one of their tables as it looked when used for a parlor table, dining table and kitchen table.

G. J. Booth showed a line of vacuum cleaners and electric vibrators.

Burnite Machinery Co. showed one of their combination electric and hand hoists, different styles of air drills and the Lyons steel locker.

Burroughs Adding Machine Co. exhibited one of their electrically driven machines.

The Cahn-Forster Electric Co. showed their Premier vibrator and the Mach therapeutic outfit.

Exhibit of Capital Electric Co.

Capital Electric Co., makers of Hall lamps, exhibited their machine for making stems for filaments. They also had a display of all the different types of lamps, attractive electric signs and a case showing the material and ore that is used in making the tungsten lamps. They also had a meter showing the difference between the current consumption of a Mazda lamp and a carbon.

Carstarphen Electric Co. had an attractive booth

Exhibit of Carstarphen Electric Co.

on the main floor, besides the booth downstairs known as the "chamber of wonders." In the booth upstairs were exhibited an X-ray outfit in operation; two generating panels, two distributing panels made from Vermont blue marble, also one built from Colorado white marble, the first one built in Colorado. They also showed an extensive line of dry cells.

Central Colorado Power Co. showed their tower and insulators, also a sample of the wire used in transmitting 100,000 volts, with a map showing the territory covered.

Central Electric Co. of Colorado Springs showed their electric water boiler and different electric cooking appliances.

Classon Map Co. showed their electric blue printer in operation.

Colorado Machinery & Supply Co. showed a motor driven pump in operation, fly wheels and different types of steam whistles.

Colorado Telephone Co. had the central office in the show. They supplied free telephones for all the booths and free public service both in the building and on the outside. They also exhibited their old switchboard that they used twenty years ago and the one now in use.

Cook Railway Signal Co. showed their old style of gate and block system, also their latest patent giving a practical demonstration.

Curran Co. displayed electric signs.

Denver Omnibus & Cab Co. exhibited Exide storage and ignition batteries for gasoline automobiles.

Denver City Tramway Co. had a unique booth showing the appliances used twenty years ago and those used today in connection with street railway operation. The old style controller and the improved controller, the old style armature and the latest patent, the different sizes of nails used, the patent Kitt electric switch which is used all over the system, different types of lightning arresters that they have used, with demonstrations, and samples of trolley wire. They had some very interesting posters showing the result of stepping off the car backwards.

Denver Dry Goods Co. exhibited portable lamps, furniture and cut glass and had the booth beautifully decorated with hot house plants.

Denver Electrical Co. exhibited electric fixtures, heating devices and novelties.

Denver Electric Wiring Co. demonstrated their latest cooking and household utensils.

Denver Post offered prizes to boys bringing the best home-made machines. There were two classes, A and B. The first prize for Class A was $100, the second $75. First prize for Class B was $75, second prize $50. Those who competed for the prizes were: Aubrey Force, model of a monoplane; Mark Avery, aeroplane; William Bowels, electric firehouse; John Broadbrook, electric automatic switch; Frank Rittick, triplane; T. Banks and W. H. Smith, Tesla coil and spark; Edward Doyle, C. L. Wood, Walter Anderson, W. S. Gromm, Robert Hamilton, wireless telegraph apparatus. The winners: First prize, Class A, W. S. Gromn; second prize, Class A, Edward Doyle. First prize, Class B, Theodore Banks; second prize, Class B, Robert Hamilton.

Exhibit of Denver Rock Drill & Mining Co.

Denver Rock Drill Co. exhibited an extensive line of machinery, giving demonstrations of drills and electric pumps.

Denver Gas & Electric Co. illustrated the equipment of a modern electric home of five rooms, a hall and a bathroom, each being equipped with an electric call bell and efficient electric illumination. The living room was further equipped with an electric grate, electric piano and lamp, electric fan and electric ozonizer, the dining room with an electric chafing dish, toaster, coffee percolator and electric flowers; the kitchen with an electric range, water heater, waffle iron, sad iron, toaster, fan and disc stove; the bedroom with an electric curling iron, sad iron, vibrator, vacuum cleaner, fan, heating pad, food warmer and milk warmer; the bathroom with an electric shaving mirror, heater and coil; and the laundry with an electric washing machine, iron and mangle. This company also had an industrial exhibit in the basement at which they showed an electric dishwasher, clothes washer, laundry stove and clothes dryer, as well as electric soldering irons, glue pots and tailor irons.

Electric Laundry.
Exhibit of Denver Gas & Electric Co.

Electric Bathroom.

Electric Kitchen.
Exhibit of Denver Gas & Electric Co.

Electric Fireless Cook Stove Co. demonstrated their stoves.

Electric Motor Equipment Co. showed a complete electric laundry outfit in operation, also a line of vacuum cleaners, besides other appliances.

Electric Storage Battery Co. displayed "Choride" and "Exide" accumulators and small lighting outfit for farm use.

Electric Supply & Construction Co. exhibited Vortex vacuum cleaners and Imperial washing machines, both in operation; also a line of fixtures and other appliances.

Ellis Electric Sign Co. exhibited samples of their electric letters and photos of different installations around Denver.

Felt & Tarrant showed the Comptometer in operation.

Flint Lomax Mfg. Co. had an interesting booth in the basement where they exhibited their electric power hammers, welder, electric box drill, automatic screw machines and Doherty's gas colorimeter in operation.

General Acoustic Company exhibited the Acousticon, the Dictograph, and the Dimaphone.

General Electric Co. had an attractive booth and gave practical demonstrations of all the different appliances that were exhibited. They exhibited a full line line of heating and cooking devices, including a new type of electric range. A complete line of motors for household use were shown, as was a small motor for grinding purposes, also an automatic flow control pump. Full line of electrical Christmas tree decorations, giving demonstrations of the different kinds of fruit represented in electrical bulbs. A full line of meters both of steam and electric, also a new type of the prepayment wattmeter. A gasoline generating set which is used in government work was shown in full operation, also a 25-kw. steam turbine in operation. There was also exhibited a three-phase induction motor with automatic overload and no-voltage release, a d.c. and a.c. new type motor with new type starting device, a new type single-phase variable speed a.c. motor, also a motor-driven sewing machine on which men made bonnets that were given to the ladies. The booth was beautifully illuminated by 500-watt Mazda lamps. The sign "General Electric" contained 422 electric bulbs. Candy bearing the sign "G. E." and cigars were given out.

General Vehicle Company made a display of electric trucks for commercial use.

Great Western Oil Co. displayed their different grades of oil in attractive jars.

Hadley & Hine exhibited Elliott and Fisher electric billing and adding machines, Barnett adding and calculating machines and Flexotype electric duplicating machines.

Hendrie & Boltholff Mfg. & Supply Co. displayed

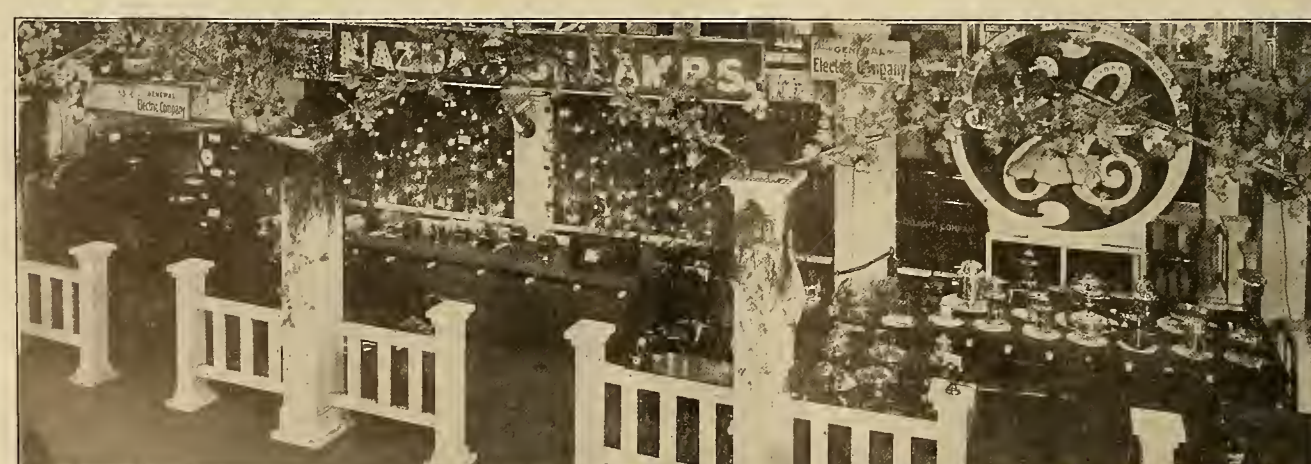

Exhibit of General Electric Co.

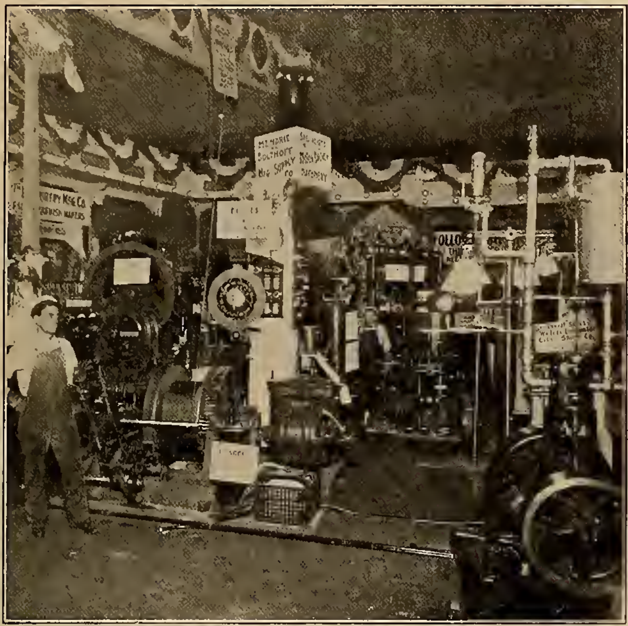

Exhibit of Hendrie & Boltholff Mfg. & Supply Co.

a full line of machinery, all of which was in operation. This included Aldrich mining pumps, Jackson centrifugal irrigation pumps, Paul deep well pump, Deming deep well pump and Hendrie & Boltholff mine hoists; Fort Wayne motors, generators, meters, transformers and controllers; Condit switches and circuit breakers; U. S. electric tools and a full line of wiring supplies and specialties. Their electric hoist attracted much attention, being used to hoist a bucket to the ceiling.

Jackson & Wood exhibited a variety of their automobile lamps, also four different colored lamps attached to a wheel, which when rapidly revolved made a pleasing sight.

Krebs-Covington Auto Co. exhibited one of the latest models of Detroit electric coupes.

McPhee-McGinnity Art Glass Co. had a display of the different colored glasses used in their domes and shades.

Mine & Smelter Supply Co. exhibited a 25-h.p. electric mine hoist, magnetic clutch, Yale & Towne triple chain blocks, a small irrigation plant in operation and an electric drill.

Lindrooth - Shubart Company, Denver, showed Goodman electric locomotives, Kerr steam turbines, turbo generators, and Ridgway automatic engines and generators.

McMurty Paint Co. exhibited a full line of paints, stains and varnishes.

National Carbon Company, Cleveland, Ohio, exhibited a line of arc-lamp carbons, brushes and batteries.

National Electric Lamp Association occupied four booths to the left of the main entrance. The booth was tastefully decorated with flowers, palms and foliage. A pergola in the rear served as a reception room. Besides the regular lines of Mazda and tantalum 110 and 220-volt lamps shown were the Mazda street series and sign lamps, the new 400 and 500-watt Mazda lamps, a complete line of Mazda and tantalum round bulb, meridian and Mazda miniature lamps. Mazda lamps equipped with Holophane reflectors were shown burning on one rack, the new double-wound tantalum street railway lamps were shown in contrast with carbon street railway lamps on another rack, the power consumption of each being shown by an integrating wattmeter. A small Bunsen photometer and a model of a rotating mirror photometer illustrated some of the methods used in measuring light. The latter also illustrated the distribution of light about a Mazda-Holophane unit. A number of automobile fixtures were shown equipped with six-volt Mazda automobile lamps lighted from storage battery. An interesting historical feature was an exhibit of Goebel lamps made by Henry Goebel of New York in the early 60's.

Mountain Electric Co. showed vacuum cleaners in operation, also different types of motors and electric irons.

New England Electric Co. showed different types of telephones and also an assortment of Klein tools, conduits, condulets and different sizes of lamps and fuses.

Northern Colorado Power Co. showed a map of the territory they cover and exhibited motors and vacuum cleaners.

Northwestern Supply Co. exhibited a line of their insulators and showed a model of the tripartite steel tower.

Exhibit of National Electric Lamp Association.

Exhibit of Albert Sechrist Mfg. Co.

Ogier, Silsbee & Ogier Creosoting Works showed poles, ties and fence posts that had been treated with creosotes, also cross-sections showing the depth of penetration.

Ohio Brass Co. showed different sizes of insulators.

Onderdonk Engineering Company represented Babcock & Wilcox boilers, asbestos goods and Lagondo boiler specialties.

Park Floral Co. had a beautiful booth filled with different varieties of flowers.

Robinson & Rogers Supply Company, Denver, exhibited Hughes electric ranges, Sykes electric fireless cookers and other electrical devices and appliances.

Sangamo Electric Co. exhibited a line of their ampere hour meters for electric wagons.

Albert Sechrist Mfg. Co. occupied six booths at the extreme end of the building and were attractively decorated. The first contained cut glass domes, portables and ceiling fixtures; second, shower fixtures, crystal brackets and a beautiful bronze figure; third, a complete line of crystal fixtures; fourth, fixtures of shower effects and ceiling pieces; fifth, ceiling pieces of bunches of crystal grapes and shower effects; sixth, principally hammered brass work, giving demonstrations of how the flat brass is formed in the many different shapes of shells.

Sells Candy Co. sold candy and showed an attractive line of candy boxes.

Chas. A. Schieren Belt Co. showed a complete line of belting.

Silver State Electric Co. exhibited a motor partly wound, also their patent electric automobile horn, giving demonstrations.

Simplex Electric Heating Company, Chicago, Ill., displayed a full line of electrical heating appliances.

Smith Brooks Co. showed one of their electric presses in operation, also different samples of printed matter, such as posters, folders, postals and stationery.

Standard Electric Utilities Co. occupied three booths with their Vohr electric ozonizer, giving demonstrations of purifying the atmosphere.

Stearns-Rogers Mfg. Co. exhibited a model of a Heine boiler, Haines air pump, Dorr classifier, and Ingersoll air drill and other appliances.

Exhibit of Westinghouse Electric & Mfg. Co.

Studebaker Vehicle Co. showed one of their 2500-pound electric trucks.

Thomas H. Smith Co. showed a line of motors in different stages of construction. Their booth was decorated with the tape used in the winding of armatures.

Technical publications represented included the Electrical World, the Electrical Review and Western Electrician, the Journal of Electricity, Power and Gas, Motor Field and Mining Science.

Wagner Electric Co. showed a complete line of their appliances, also two of their flaming arc lamps which brilliantly illuminated their booth.

Western Electric Co. exhibited a large sphere showing the different places throughout the world where they do business. They also displayed intercommunicating and house telephone supplies.

Western Electric Signs Co. demonstrated their method of lighting signs and showed the different types of signs and letters.

Western Engineering Specialties Co. showed washing machines, vacuum cleaners, electric soldering, hair dryers, massage outfits and their patent steam trap.

Western Vacuum Cleaner Sales Company, Denver, exhibited Keller-Santo vacuum cleaners.

Westinghouse Electric & Mfg. Co. had four booths, the corner entrance being fitted up with a miniature electric fountain which continually flashed the different colors through the water and a beautiful rose plant with the heart of the roses made up of small incandescent lamps. The next booth was called the "flag room" and in this place the Westinghouse Co. made with their sewing machine motor the largest American flag in the world, its width 68 ft., length 136 ft. The stars were 36 in. from tip to tip and each stripe 5¼ ft. in width; it contains 2300 yards of wool bunting and required about 72,000 yards of thread. This flag was finished on Thursday and with an impressive ceremony it was presented to the City and County of Denver, the Mayor and city officials being present. In the next booth was displayed the Westinghouse heating apparatus, their toaster stove being demonstrated. The last booth was used as a motor exhibit; one of the 125-h.p. motors which had operated 150,000 miles on the Denver & Interurban Railroad between Denver and Boulder was on display, looking none the worse for wear; there was also shown a 75-h.p., 2000-volt motor; their "CCL" small induction motors as well as their new mill type induction motor. Their whole booth was made up to represent a grape arbor with large clusters of grapes with incandescent lamps inside.

Softening of mica, to better suit it for the manufacture of insulating layers for commutation segments, may be accomplished by heating it to a temperature just below redness and then suddenly cooling it in water, thereby retaining its toughness.

Wireless lighting of incandescent lamps is reported from Copenhagen where Valdemar Poulsen, the inventor of the Poulsen system of wireless telegraphy, is said to have lighted two incandescent lights in one room by means of his transmitting apparatus in another without the aid of any ordinary mechanical connection.

CREOSOTE TREATMENT OF POLES.[1]

BY GEORGE R. OGIER.

During a conversation recently with one of your members, it was suggested that I come here before this meeting and talk on the creosote treatment of our native lodgepole pine poles. Although I accepted this task, anticipating a great deal of pleasure, I am not quite sure that my paper will convince all of the full importance of this matter and subject. However, I have endeavored to set forth the most important phases of the subject, in order to have a paper of a limited number of words, and yet have the desired effect.

First, for the benefit of those not familiar with the general subject of wood preservation, I will relate something of its history. Wood preservation is an old art, and has been practiced since the beginning of the 18th century. In 1705 Homberg soaked wood in an aqua solution of corrosive sublimate. In 1730 Job Baster saw the worth of this important subject when treating wood for shipbuilding purposes with an aqua of corrosive sublimate and arsenic. In 1740 Reed used wood vinegar. In 1756 the process generally used for preserving wood was by dipping it in boiling hot wood tar, and then later, about 1812, coal tar was first used by Cook for ships and ship timbers; and in 1838 dead oil of coal tar or creosote was first introduced as a preservative for timber by Mr. Bethell in England. Wood preservation began in the United States on a commercial scale in 1848, when Mr. James B. Frances established a cyaniding plant at Lowell, Mass. This plant is still in operation, although the amount of timber treated in it is comparatively small. About 1874 a creosote impregnating plant was established in West Pascagoula, Miss. This was the first plant of its kind erected in this country, and is still in active operation. Since the erection of this plant a number of others have been installed, the most rapid development being along the Gulf of Mexico. The gradual depletion of the timber supply, resulting in an increase in the price of the raw product, has more recently fostered the growth of wood preserving plants, especially throughout the central and eastern United States. In 1904 the total annual output of treated timber in the United States was approximately one-half billion feet b. m. In 1907 the number of plants had increased to sixty, with a total annual output of approximately one and a quarter billion feet b. m. New plants are being erected from time to time in various parts of the United States, and up to date the timber treating plants number seventy-two.

Up to the present time creosote has been recognized by our government, and those familiar with the good qualities necessary in wood preservatives, to be the best; it is the most costly and at the same time the most effective in preserving wood.

The preservation of wood from decay by treating it with chemicals which prevent the action of decay is of increasing importance in the United States. From the standpoint of the conservation of our rapidly diminishing forest resources, and the prevention of a possible timber famine, the preservative treatment of timber may be a most effective measure, because it

[1] Paper read at Eighth Annual Convention Colorado Electric Light, Power & Railway Association.

lengthens the service of the wood which is used and therefore decreases the amount necessary to supply the demand. From this point of view wood preservation has a distinct advantage over measures for the growing of more timber, since these measures require years in order to show their effect, while preservative treatment is a remedy which can be applied immediately.

Wood preservation is especially important in the States of the Rocky Mountain region, because of the rapid decay of the most of the native timbers of this region when used in contact with the ground, and the necessity, which grows more pressing with every year, of using these native woods for telephone poles, railway ties, mine timbers and many other uses which expose the wood to decay.

The Federal Government, realizing the great importance of the subject as a protection against the possible rapid decrease of timber in the United States, actively engaged in educating the western timber users to the advisability of treating the different structural timbers, about 1906. In 1908 the Government through the Office of Wood Preservation erected a simple demonstrating plant at Norrie, Colorado, for treating the timber on the National Forests. The Government's work there was to some extent experimental, inasmuch as it operated upon the fire-killed native lodgepole pine, standing in burned over forest tracts. As the outcome of these experiments it has been conclusively proven and actually demonstrated that even this fire-killed timber becomes efficient and extremely durable when treated according to the specifications of the Nation's scientific experts. But it was not permissible for the Government to do more than prove the value of the process, and as the Government does not carry on commercial enterprises, they sought private parties to carry on the enterprise, and the plant was sold to the Denver firm, of which I am a member, and now with certain additions to the equipment and enlargement in capacity it is prepared to turn out approximately 53,000 poles and six million feet b. m. of structural timbers per annum.

The Process.

The process used at our Norrie plant is what is known as the "open tank" process. The apparatus consists of three storage tanks, supported upon a platform high enough to allow the creosote to run by gravity into two treating tanks, one circular ten feet in diameter and nine feet high, and a rectangular tank twelve feet long, four feet wide, and eight feet deep. By the use of a derrick the treating tanks are loaded, oil is allowed to enter to a height in the tank sufficient to creosote the pole to the height stated in the specifications, which is about six feet of the butt on a 25-ft. pole, treating all the buried end of the pole and about one foot above ground. The creosote around the pole is now heated to a temperature sufficient to open the pores in the wood, expel most of the air by expansion, thus forming a partial vacuum. This condition is now relieved by turning off the steam, and thereby stopping the hot bath. The hot oil is replaced by cool oil, which penetrates the pole while cooling is taking place. The duration of this cool bath is made sufficient to give the desired penetration for about a twenty-year service.

The theory of the above process may be given in few words: The heat of the preservative expands and expels a portion of the air and water contained in the cellular and inter-cellular spaces of the wood tissue, and when the cool creosote replaces the hot there is a contraction and condensation of the air and water which remains. To destroy the partial vacuum thus formed the liquid is forced by atmospheric pressure into the cellular and inter-cellular spaces, a process aided, of course, by capillary attraction.

The ease and effectiveness with which timber can be treated by this process depend upon the kind of wood, and whether seasoned or unseasoned. Air is easier expelled than water, and in our native lodgepole pine timber there is very little moisture; it being fire-killed timber, therefore absorbs the preservatives more readily than green timber.

There is probably no reason for discussing the value of the creosoting process in this report, for it is believed that there is no longer any question at this time as to its positive value, provided it is well done.

Life of Creosoted Poles.

It is not merely the expense of the new pole which has to be taken into consideration, but also all the extra expense connected with it, such as the employment of skilled men to erect them.

The prices of the best grades of wood, such as cedar and oak, are becoming so high that the cost of an untreated pole laid down in Colorado is as much as a creosoted native lodgepole pine pole.

At many points in Colorado a creosoted native pole can be laid down for a less price than the imported pole, and the life of this treated pole is estimated at from five to ten years longer than any untreated pole which can be laid down in Colorado. The following is a table of data compiled by the United States Government showing the comparative life of untreated and treated poles:

Species	Average Number of Years Untreated Life	Average Number of Years Treated Life Est. by F. S.
Cedar	12 to 15	25
Chestnut	8 to 10	20
Lodgepole Pine	5	20
Western Yellow Pine	6	25
Cypress	12	25
Juniper	10 to 13	25
Redwood	12 to 15	30
White Oak	8	20
Douglas Fir	8	20

Some of the above data is estimated from test lines put in by the United States Government in cooperation with the American Telephone and Telegraph Company in November, 1906. I do not mean to say that these figures are conclusive, but they go toward showing the benefit of the creosote treatment.

At the meeting of the Dublin Section of the British Institute of Electrical Engineers, held in December, 1902, Mr. A. T. Kinsey gave some interesting figures regarding the life of creosoted telegraph poles, of which the following is an extract:

The author has traced the erection of creosoted poles in Ireland as early as 1858, and again in 1861, but a systematic branding of the date of creosoting was not begun until 1873. It is impossible to identify with certainty the poles creosoted before that time. The result of an examination by percussion showed that the poles thus branded are apparently quite as sound as when first erected. Poles dated 1877 were being taken down,

but were apparently as good as new, and would pay for re-erection.

The best available figures on the life of creosoted poles are from the German Postal and Telegraph Department, which after fifty-two years of observation gives a life of twenty-one years for creosoted Baltic pine. The use of creosote for preserving timber has been shown by the experience of the English and French lines to be beyond question a method which protects those parts injected with it absolutely. Creosote prevents that effect shown by intermittent wet and dry, and makes the timber waterproof.

Advantages.

One of the greatest advantages of creosote treatment for timber is that not only does it lengthen the life of timbers, but it makes the life of all kinds of timber practically the same, so far as decay is concerned. It will readily be seen that if our native pole which without the preservative treatment will last but from three to five years, can be made by treatment to last twenty or twenty-five years, it is much more profitable to use the native pole, which can almost always be obtained at a much cheaper price, than to use an imported pole lasting about fifteen years untreated and for that reason commanding a higher price. The use which preservative treatment makes possible of timber which without that treatment would not be usable at all, is at once a great economy to the individual and a considerable aid toward the conservation of the timber supply. The financial saving is one of the advantages, but being such an important question I have placed it under a separate heading.

The financial saving that would result each year in the United States were a uniform policy of treating timber adopted, is about $72,000,000. It should be remembered that this includes the cost of labor as well as that of the timber itself, and thus represents the amount of money that could be turned each year into other channels, if wood preservation were uniformly adopted throughout the United States.

In the following table, I have endeavored to show the estimated annual financial saving by a proper preservative treatment of poles.

				Years of Life		Annual Charge				
Material	Placed	Total	Cost Foot	Untreated	Treated	Treated	Untreated	Annual Saving	Quantity in Use	Total Amount Saving
$4.00	$3.00	$7.00	$1.50	13	23¼	$0.78	$0.69	$0.9	32,000,000	$2,880,000

This table was figured from averages by the following formula:

$$a = p\frac{1.0\,r^n \times 0.0r}{1.0r^n - 1}$$

a = annual charge, p = investment, n = years in recurring period, r = int. on investment at 6 per cent.

In many cases the consumers require in their specifications poles of larger diameter than the actual service requires, in order that a certain amount of deterioration by decay shall be allowable before replacement is necessary. For example, it is computed that a circumference of not less than 28 inches of sound wood in the pole at the ground line is required to support the strain to which the line is liable to be subjected, and the poles used have a circumference of 36 inches at the ground line, then 8 inches deterioration or the equivalent of a depth of decay of approximately one and a quarter inches is allowable before replacement is required.

In some species otherwise durable the sapwood decays very quickly. Untreated white cedar poles in Georgia, inspected after being set in line four years, showed 45 to 50 per cent of the number with sapwood completely decayed at the ground line, which amounted to an average deterioration of four inches in the circumference, equivalent to an average depth of decay of fully 5-8 of an inch. Cypress poles in Florida, inspected after being in the ground seven years, showed an average depth of decay of 0.8 inch at the ground line. The heartwood of these poles is sound and in nearly all cases is of sufficient dimensions to meet the requirements of the line in which they are used, although graded by the butt circumference they fall decidedly lower than their original class. If poles originally of the same grade represented by these poles after the sapwood has decayed had been used, and the butts well treated with creosote so that their full size and strength would be maintained, not only would the poles be equally as strong as the ones now in use, but their ultimate length of life would be greater. The difference in cost between the two grades of poles in some cases would largely offset the cost of the treatment. It appears that pole users are paying money to secure large diameter sizes of poles in order to secure longer life, that might more profitably be spent for preservative treatment. The possibility of using lighter poles and giving them preservative treatment so as to maintain their full size and strength is one that merits the attention of all pole users.

Wood preservation, then, accomplishes three great economic objects:

(1) It prolongs the life of the durable species in use;

(2) It prolongs the life of the inferior and cheaper wood;

(3) It enables the utilization of these inferior woods which, without the preservative treatment, would have little or no value.

I believe, and most any one who has considered this important subject will agree with me, that the time is at hand when all companies will find that they are obliged to have all their poles creosoted, as at the present high prices of both labor and poles it is too expensive to have to be constantly renewing them.

PRESERVE WOODEN POLES.

It is estimated that there are required for renewals between 500,000 and 600,000 poles per year, and that during the next ten years this number will be increased to 900,000 to 1,000,000. As a result of direct inquiry from a large number of transmission companies, the life of various timbers when used for transmission poles has been calculated as follows: Cedar, 13½ years; chestnut, 12 years; cypress, 9 years; pine 6½ years; and juniper, 8½ years. A committee of the National Electric Lamp Association recommends strongly that the different companies should keep accurate and complete records of poles and cross-arms and collect authentic statistics and literature pertaining to wood preservation.

SOME OBSERVATIONS ON CULTIVATING FRIENDLY RELATIONS WITH THE PUBLIC.[1]

BY J. M. CONNELLY.

Every industry that depends to a great extent upon public favor is taking some cognizance of the bad feeling evidenced in some quarters against the operations of large capital, and several of our large industrial associations are devoting much time and serious study to determine the exact causes of this unrest and to find a remedy for it. The subject is especially uppermost in the minds of those having the management of public service corporations, and in recent years as a result of the attention given it by the National Electric Light Association and its section members, more progress has been made in cultivating a friendly feeling between the companies and their customers than during the whole of the previous life of the association. It would seem that concentrated effort by the large and small units of the electric industry can accomplish as much towards removing undesirable influence in this connection, as has been done in solving the many operating difficulties that have continually confronted companies since the birth of the electric light, power and railway business. Co-operation in coping with this problem is as important, if not more so, than in working out other bad tangles, and this particular worry and bother are sure to give way before the brains that have solved greater perplexities.

We cannot blame the justice of the people's attitude towards indifference on the part of a utility corporation in the matter of good service, and, on just cursory analysis, it is evident that a company is but throwing away business to persist in such arrogance. Nor can any defense be reasonably urged in support of a management tolerating a scant and shabby courtesy towards the public. When it is so easy, and much more profitable, to say a kind word and wear a smile, it is strange company managers are not rigorously insistent that their employes treat customers with unfailing courtesy. However, even when a manager lays down the policy of giving the public the best possible treatment, it is sometimes difficult in execution. The company must deal with the public through its employes, and we all know how prone human nature is to occasionally become officious when clothed with a little authority. The public does not understand that one of the hardest problems for a well intentioned company is to secure men for the different positions who will at all times preserve an even temper and remain the gentleman, no matter what the provocation. As we have frequently heard, a company's employes are largely responsible for the judgment passed upon it by the people. If they are haughty, overbearing, impudent, blunt or peevish, a bitter enemy is made for the company, and the nimble tongue with a grievance to voice against a corporation is sure to cry from the housetops, and usually finds a sympathetic audience. On the other hand, where the employe is courteous, polite, civil, urbane or conciliatory, as the occasion requires, the company makes a friend who will always be ready to say a good word for it. We know of a certain company employe who comes in contact with a number of kickers. They approach him hot-tempered and abusive. He listens complacently to their sputterings and cheerfully returns smile for scowl, the gentle word for the harsh epithet, the kindly eye for the savage glare. So completely does he keep himself in hand that he is scarcely ruffled by the foulest abuse. His courtly demeanor makes the worst cranks his best friends. He says that in the majority of cases he receives apologies for the abuse thrown at his head. That man is one of the most valuable assets of his company.

The old regime of the corporation bound and blinded by a foolish independence erroneously considered one of the excellent advantages of a monopoly, has passed to a deserved oblivion and the principles that obtain in the transaction of private business under the discipline of competition, are being largely employed by the utility companies in dealing with their customers. We do not know that this has come through an improved morality, but we certainly have discovered that fair dealing and fair treatment pay. This is proof enough that the golden rule has as much efficacy in our business as in every other, and the manager who cleaves to the old practices, is taking no note of the growing high and broad standard of business dealing in the electrical world.

If we would contribute our power and influence in nourishing the growth and prosperity of the community in which we operate, we must appeal to the public to leave us free of unreasonable and unjust restrictions. We must ask them to assist us in maintaining our credit so that we may meet our obligations and satisfy the demand for adequate and efficient service. In the West we are growing at such a tremendous rate that it is difficult for a public service corporation to keep pace with the increasing demand on it. It would seem wise to at times inform the people about the expenditures necessary to anticipate the future, so that they can better understand that it is a man's job to raise capital for a plant in a growing city.

No business has suffered more hardships than ours during the brief term of its existence. We have overcome many of the worst difficulties, but there are yet some, the settlement of which will serve to more firmly establish the industry and win for our securities permanent respect and popularity with investors. In spite of the doctrine about competition being the life of trade, we have seen in our business that it usually accomplishes the wreck of property. The people are finding out for themselves that the way to get a reduction in their rates is not to grant a franchise to a competing company. With competing companies in the field, they have too frequently found themselves the victims instead of the beneficiaries of such a pernicious situation. If we will but gather the large amount of data available proving the immense waste of capital and inferior service resulting from conflict between competing companies and give out that information freely where it will do the most good, we will forever coffin this kind of competition.

When the public mind becomes more receptive to our side of existing differences, we should urge our

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[1]Paper read before the Colorado Electric Light, Power and wood Springs, Colo., September 21, 22, 23, 1910.

claims for longer term franchises, and as our argument therefor is sound and convincing to a calm and reasonable mind, we can soon expect a change of public sentiment in our favor. Our credit must necessarily be limited by the short term franchise, and on this account the customers of a company are sure to suffer in the later years of the life of the franchise. As we mentioned before, the cities of the West are growing much faster than in any part of the country, and it takes large amounts of capital to provide for the future. It is impossible to finance enlargements and extensions towards the end of the life of the franchise, and in consequence both the company and the people suffer. The service necessarily remains practically at a standstill until something is done to amply secure investors ready to advance the money for betterments. In a report made by the public policy committee of the National Electric Light Association to a convention of that organization in 1907, it was pointed out that the franchises of the companies should be for such terms and upon such conditions as will best subserve the interests of both. It declared that undue restrictions of franchises were analogous in their results to the imposition of unwarrantable taxes. It also indicated that the short-term franchise removed all incentive for the company to make permanent improvements, especially in the latter part of the life of the company. All of these facts in relation to the matter of the securing of franchises of longer term have been strangely slumbering, and there appears to be some unexplainable reluctance or negligence in submitting their merit to the people.

That a public service company can get a hearing and also liberal encouragement from the people in some parts of the country, was brought out in an interesting and convincing speech recently made before the Electric Club by a former Democratic Mayor of Denver. He said that the people will pat a corporation on the back that helps in the upbuilding of a city, provided there is organized co-operation among the elements in a community that can keep the wheels of progress going. The trouble with Denver, and he might have said about the whole of the State of Colorado, was that there was one side trying to build up and another trying to tear down. He contrasted this condition with the spirit of Los Angeles, where the man who brought in large capital was given a handshake instead of a kick. However, if we will stop to consider the element making the kicks against the public utility company, we can hardly get away from the conclusion that we, ourselves, are largely responsible for a good many of the delusions hugged by the dear public. Isn't it a fact that most of us have sat back in our mahogany and allowed our traducers to howl their denunciations without lifting a voice of protest to put our side of the question before the people. If you go before a judge or jury, you don't allow your case to go to final consideration until you have exhausted every means of presenting fully and persuasively your views of the differences involved. Why shouldn't we bestir ourselves as much when questions of public moment affecting us are brought into prominent notice. The majority of the people will listen to reason. The reformer with malice rather than justice for a motive, will not have a dominating influence in your community if you stoutly contend for your just dues. Say what you will about the hopelessness of arguing to a radical element in a community, if you have right and justice in your cause, you will win if you fight your battles with the feeling that you truly deserve to win. Certainly, people will get the wrong impression of you and keep it if you do nothing to root it out. In this connection we wish to call your attention to a case in point. An association of employes of a Denver public service company held a banquet one evening not long ago and the speaking was devoted to the best methods of stopping kicks and winning the good will of customers. The guest of the evening was a brilliant editorial writer of strenuous municipal ownership tendencies. He went to the banquet somewhat reluctantly and for a time acted like a man dwelling in the camp of the enemy. When speech after speech was made dealing with the problems of good service and caring for complaints, he evinced the greatest surprise and was astonished that a great public service company gave such earnest consideration to the question of pleasing their customers. In a speech which he made towards the end of the evening, he confessed that for some time he looked upon public service corporations as buccaneers, and said he felt obliged to rub his eyes and wake from his trance when he heard the speakers discussing ways and means of giving the public good service and good treatment. Nor did he stop with his speech in giving expression to his astonishment. In a lengthy editorial a few days afterwards, he related his experience at this banquet and said that a new era had dawned in the practices of the big corporations which would insure the people the service and treatment to which they were rightfully entitled. If we could give the newspapers frequent cause for such expressions, some of the undeserved odium which attaches to us would soon disappear.

The practice of advertising with a newspaper in the hope of gaining its favor, irrespective of the value of the advertising, is spending money foolishly. A newspaper that could be so influenced deserves the respect of no one, and whatever it says for or against you will have little weight in the community in which it circulates. If a newspaper owner is unprincipled, his every act will be tainted with his defective character, and if he isn't on the level, you will gain more by keeping away from him. You might be friendly with him and stay the blow of his journalistic cudgel for a time, but when he found it more profitable to swing on you, he would not hesitate to do you harm. Honest journalism must be distinguished from the pirate, prowling kind, seeking revenue only, and it is to the sincere and undefiled public prints we should plead our cause. We have no quarrel with the newspaper that stands for fair and square dealing, for such a newspaper is always ready to throw open its columns to your side of any serious question.

There is a disposition with some of us to ignore all kinds of publicity. The man who feels this way is miles behind the procession in the electric industry. All the people read the newspapers and most of those people indirectly shape legislation affecting us. It is important that we cultivate friendly relations with our

influential newspapers, so that we can correct their mistaken notions and supply them with accurate information about our business. Don't flare up if, in the language of the prize ring, an editor takes a wallop at you. Accept your punishment good naturedly, but point out to that editor how shamefully he has fouled you. Shower him with facts to show him he is wrong. You will find that most newspaper men are not such a bad lot and there is much of the milk of human kindness in them. The trouble is that we are too much inclined to rub them the wrong way, and you yourself know that no matter how just you want to be even to your enemy, it is human nature to occasionally jab him when the opportunity presents itself. We have in mind a certain company manager who had some bitter things said about him before he learned the value of being civil to reporters. He purposely allowed them to cool their heels for hours outside his office whenever there was big news to be given out and his interviews were mainly monosyllables uttered with a grunt. No reporter ever lost a chance to take a fall out of this individual. There was an unwritten law in every newspaper office in that city, that whenever the occasion presented itself Mr. Blank was to be dealt with without gloves. So from time to time this gruff gentleman received a grilling that finally reached under his hide. He asked a friend of his one day what he had done to make the newspapers so vindictive towards him, and this good friend out of the charity of his heart told him that just a little courtesy towards the reporters would soon effect a miraculous change. He grudgingly assented to the suggestion and began to treat reporters like human beings. Little by little, this bit of sociability had its effect and as reporters are now always welcome to his office, the personal bitterness has disappeared from the columns of all the newspapers.

Let us consider another case where a man's personality and goodness of heart operate to stave off unfavorable criticism. This man is the head of one of the largest public service corporations in Colorado. His second nature is to hand every one he meets a cigar or stronger refreshment if desired, and it is said that every newspaper man in Denver would, figuratively speaking, sooner cut off his right arm than say an unkind word against him in their newspapers, and this includes those newspapers that are strongly anti-corporation. So magnetic is his influence that not one word has appeared in criticism of his interests since his company began operating in Colorado. This is an uncommon case of an official being able to do incalculable good for his company by force of a happy and inspiring personality.

There is another man whose method of dealing with newspapers will be of interest. He has won praise in every position he has held in the electric world, and most of us could speed more quickly to success by patterning after some of his methods. He absorbs facts as a sponge takes up water, and when necessary knows how to present them. His directness has been one of the chief elements in his success, and in the handling of business demonstrates the geometric truth that a straight line is the shortest distance between two points. No citizen of Colorado keeps better posted on everything concerning his business and few are more familiar with the public pulse. When facts concerning his interests are misstated in the newspapers, he does not boil over them in his office, but quickly beards the editor in his lair. This is what every newspaper wants. It desires personal contact with the heads of our companies, and when we condescend to get off our high horse and meet the newspaper men on common ground, we are pretty sure to escape a considerable amount of newspaper punishment.

There is a newspaper man in this body who served ten years as a reporter and editor on several large metropolitan dailies. He tells some facts which show how reporters—the men who go out to gather the news that makes the paper—often get the worst impressions of heads of large corporations just because these men deny themselves to newspapers. This former scribe says he frequently tried to interview a certain public utility official of great influence in the west and in eastern financial circles. He was never able to get beyond the railing of the outer office, and this was generally the case with the men on the other papers. The official kept himself screened from the public view during his office hours with as much ceremony and mystery as any oriental potentate, and the wiliness of burglars would have found it impossible to break into the throne room with a "jimmy." Now, such exclusiveness would not be expected to stimulate a very high respect for that man from newspapers. The things said about him by the reporters would not look well in print, yet our member newspaper friend found later after he left the newspaper business that he was entirely mistaken in the man. He had occasion to go to him on certain business and not only was he able to gain immediate entrance to the inner office, but he was also given a hearty and cordial greeting. The former reporter was dumbfounded. To expect to meet a man of satanic characteristics and repellant personality and then experience the amazement of stepping into the presence of a kindly, able man, whose quite evident force of character compelled immediate admiration, is not an experience of frequent occurrence. Now there is no public man in the West who has received as much newspaper abuse as this gentleman, and why he never capitulated to the newspapers in the small matter of granting personal courtesies, has always been an enigma to those in the habit of giving much thought to the question of the relations between the public service companies and those responsible for the shaping of public opinion. Certainly there is no doubt but what he could have done much to reduce the savage criticism against his interests which has resulted largely from his habit of exclusiveness towards newspapers.

We can go to the East and find numerous cases of prominent business figures flinging away their armored reserve and courting the friendship of the newspapers. Until a few years ago, John D. Rockefeller put the proverbial oyster to shame in preserving a sphinx-like silence. The muckrakers mucked and mucked, but their most heroic efforts didn't put a dent in his determination to keep his lips sealed so far as talking for publication was concerned. But Standard Oil abuse developed into a condition of hysteria that had a melting influence on the richest man in the world. His friends knew of the kind and affable side to his char-

acter and they pleaded with him to take the country into his confidence and change the prevalent opinion that he was possessed of a heart of adamant and the instincts of a wolf. And the world was startled one day when John D. threw down the bars and broke the silence of a lifetime. Since that time, tons and tons of papers have been used in telling of the better side of the man, and there is hardly a week goes by but what we read some wise counsel given by this old man who is devoting the closing years of his life to many and worthy philanthropies. Rockefeller will undoubtedly go to his grave with the maledictions of many, but it is certain that had he persisted in keeping a padlock on his lips and a barrier of exclusiveness against an insatiable public curiosity, this generation and posterity would know him only as a cruel and tyrannical plutocrat who had employed colossal financial ability to crush his competitors and enslave the masses.

And so it was with Harriman, and is today with many of our great captains of industry. They see they must use publicity to destroy mistaken impressions of them and place their side before the people. In fact, it is well known that no great man is today without a press agent whose office consists of placing such publicity as will be of benefit to his employer, and of using the influence of his friendship with newspaper men to persuade them to discontinue any line of criticism that can be shown to be unjust. However, any man can be his own press agent if he will only employ a little horse sense and try to learn the ropes of our various kinds of journalism.

We wish it understood that no attempt has been made in this report to construct a compendium of principles on this subject, the practice of which would bring you a state of blissful security and peace, much as we would like to discharge such valuable ministrations. In our feeble way, we have sought to spread before you some of the knowledge sprung from within our own industry and in other fields, and if our efforts will be productive of good among the members, then we will surely feel amply rewarded for our labors in the study, investigation and observation of facts and conditions herein described. We only hope that next year will bring about reports of greater progress in cultivating friendly relations with the public and that the time is not far distant when we will all be able to relish the same relief and immunity from unjust public criticism now enjoyed by any honest and well conducted private business.

GAS PLANT ECONOMIES.[1]

BY SHERWOOD GROVER.

To do absolute justice to this subject would require a review of practically all the proceedings of the various gas associations, engineering and chemical societies to date, for the gas business involves the A B C and fundamental laws of both mechanical engineering and chemistry. Although it is not my intention to discuss this question in such detail, it is practically impossible to prepare even a brief article on so broad a subject without being guilty of repeating matter which has already been published. The writer therefore makes due apology to any and all who recognize herein some child of their own brain parading in a different suit of clothes or mayhap even nude. No claim is made for originality, and effort will be made merely to treat the subject in a general way, any original thought, if such there be, speaking for itself.

A gas plant is essentially a chemical manufacturing establishment like a powder works or paint factory, but it differs from all other manufacturing establishments in the manner of distributing the finished product. A gas plant relies on the engineer to handle the product until it is delivered to the consumer on the consumer's premises, while other manufacturing plants turn their finished product over to a teamster or a railroad.

From this fact it also follows that a gas plant is a method of investing capital by which dividends are earned on bonds and stock, and therefore after a plant is completed in every detail, ready to deliver gas to the consumer, we may regard it as a kind of grinding mill, into the hopper of which we pour the money to buy the raw products and the labor necessary for the fabrication of the finished article, and from the bottom of which we take the money which we got from the consumers as the price of our finished product. The factor which determines the relation between what we put in at the top and take out at the bottom is the economy of the plant.

The economy of a plant can best be divided into two branches: the economy of installation or construction and the economy of operation.

Economy of Installation.

As the construction is naturally the beginning of a gas plant, let us first consider in a general way a few of its essentials. After a territory has been surveyed, with a view to installing a gas plant, and the advisability of such installation has been definitely determined, the first economy is the most advantageous location of the gas works. The earliest elementary books on the gas business will tell you to locate the works at the lowest point in the territory to be supplied, at the same time having due regard to the most advantageous transportation facilities for your raw material. Although the development of high pressure distribution has to a certain extent nullified the advantage obtained in distributing from the lower level to the higher, we know that high pressure is limited in its field and therefore this fundamental economy remains unchanged.

In the construction, the first and foremost economy which can be applied is that of absolute safety, particularly in foundations.

Assuming that the design is as near perfect as possible, the next is in the selection of machinery, and it is needless to say that only the best should be chosen. All of the latest labor saving devices as well as those for improving efficiencies of moving machinery should be installed. When the engineer lays out the steam generating and distributing system, he should bear in mind the best practice in power plant design, that dry steam is as desirable in a gas works and that a steam separator belongs on a gas generator as well as on a high speed engine. These facts are obvious and when an engineer has the opportunity to build

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, September, 1910.

a complete new plant to suit a given condition, there is no excuse for not building on lines of greatest economy. Unfortunately this is not the condition which engineers and superintendents are generally facing in the West. We are developing a new process, and at the same time endeavoring to keep pace with a growth and consequent demand for our product, which I believe is unparalleled in the history of the gas business. There may be isolated cases of rapid development, but with our case it is general throughout the territory and due to natural growth, and not to any special campaign of advertising or education on the part of the gas company. The ensuing tables are quoted as two examples of this growth in places which widely differ in size. They are the extremes in size of the plants coming under the writer's observation and others could be quoted ranging between the two.

TOTAL SALES PER ANNUM.

Year	Plant No. 1	Plant No. 2
1900	227,035,600	
1901	267,662,600	
1902	306,827,600	2,829,700
1903	406,999,600	5,054,000
1904	490,914,700	7,872,300
1905	563,005,600	10,411,100
1906	880,622,800	11,498,600
1907	1,260,852,700	15,074,500
1908	1,394,254,200	17,420,200
1909	1,438,115,280	19,586,300
1910, including August....		15,295,800

Almost all of our plants have passed through the stages of being coal-gas plants, combination coal and water-gas plants, water and oil-gas plants, and now finally becoming lampblack gas, which is water-gas made from the lampblack by-product of the oil-gas process. This lampblack gas has now reached the stage where a lampblack gas machine can be designed for a given oil-gas plant to use all the surplus lampblack, thus making a perfect balance. This was explained in Mr. E. C. Jones' paper before the American Gas Institute last October.

With plants which are the result of such development it is obvious that there may be many existent faults of design which by a little study and care can be remedied. The relative positions of the generators, boilers, lampblack separators and moving machinery should be carefully considered with the following points in view. Where lampblack is used for boiler fuel, the separators must be located with a view of economy in handling; in a small plant where hand labor is used entirely for lampblack it is almost impossible to locate the separators too close to the boilers, while in a larger plant, where mechanical handling is the rule, the matter of storage must be considered and location made so as to not only supply boilers economically but also lampblack gas generators as well. Between the generators and separators the main thing to consider is a short direct lampblack drain of ample size avoiding sharp turns which tend to bank up the lampblack.

That the moving machinery and generators, where the greatest amount of steam is consumed, should be so located with respect to the boilers as to insure the shortest possible steam line, is obvious. There are, however, a number of minor uses of steam which if not carefully watched are sources of small loss individually, but in the aggregate are considerable, i.e., steam used in scrubbers, foul mains, relief holder drips, etc. All leads for such purposes should start from the main steam line with a controlling valve so that they contain live steam only when in use, and these controlling valves should be so placed or equipped with extension handles that a man does not have to climb a ladder to operate them. It would seem unnecessary to emphasize the necessity of properly covering all steam drums, piping, etc., with non-conducting material, but it is a matter which is too often slighted, especially in the little side extensions of steam piping which are made from time to time. This may be a relic of the time when the disposal of lampblack was a problem and there was a tendency to overlook minor steam wastes on this account, but now with the production of lampblack practically under control these minor losses must be guarded against. Such losses consist in the transfer of heat from the steam to the air and such transfer is directly proportional to the difference in temperature between them, hence other things being equal the higher the temperature of the steam the greater the loss.

The insulation of pipe lines should not be confined to those carrying live steam alone, but also should be carried out on exhaust pipe, feed water heaters and piping, oil heaters and oil pipe from heater to generator. It might be well to note in connection with oil heaters that where exhaust steam is used their design should be such as to avoid back pressure, otherwise it may be that the advantage obtained by using exhaust steam is more than balanced by the effect of the back pressure on the moving machinery. A well insulated live steam oil heater has many points to commend it, not the least of which is the fact that it will maintain constant temperature of the oil under any prolonged or varying pull. This is one of the features in our gas works which varies from plants wherein water-gas is made. We must heat nearly three times as much oil per thousand feet of gas made, and that of a kind more difficult to handle.

The matter of scrubber and relief holder connections is one of special importance in the matter of oil-gas making. The process, as developed today, differs from water-gas in the speed of generation per unit of actual generating time and has a decided peak moment of generation during this time of actual generation. Therefore, to take advantage of this peak and prolong its duration is to our advantage. By so doing the output and efficiency of the generator is increased.

The most important factor to consider in obtaining this result is the resistance of the foul main, the scrubber and relief holder connections. These should be of generous proportions, avoiding sharp turns as much as possible, but where necessary they should be provided with crosses or hand-hole elbows equipped with quick opening doors, giving an opening the full size of the main, and also affording a gas-tight fit when closed. This permits thorough cleaning in the shortest possible time.

Another little feature which is peculiar to oil-gas is the fact that the crude gas holds in suspension a certain quantity of microscopic lampblack which any amount of ordinary scrubbing fails to throw down. It does deposit in the oxide, however, and reduces its life as well as retarding its efficiency. The installation of an "ammonia washer" on the outlet of the relief

holder has been found to overcome this fault. These washers force the gas to pass through water in a finely divided state and precipitate the lampblack.

Leaving the manufacturing end of the business and taking up distribution we find that a great many plants are a combination of low and high pressure, the high being an auxiliary of the low pressure system. In such installations there is one tendency to be guarded against, i.e., the low pressure system is inclined to throw most of the load on the high pressure, and if not watched will eventually result in an installation which is top heavy, with the high pressure doing most of the work. This condition is partly a result of growth and extensions to the high pressure mains without corresponding development of the low pressure, and also due to the fact that the regulators feeding from the high into the low pressure system are set to a given pressure and, unless adjusted daily, maintain their pressure throughout the twenty-four hours and will assume the night load, if they are set for a pressure equal to that given by the storage holder, which is generally the case. If set for a pressure above that of the storage holder, still more work will be thrown on the high pressure system. The amount of this extra work varies with different conditions, the greater the distance between storage holder and regulators and the smaller the size of low pressure mains, the less the amount of work thrown on the high pressure system.

The writer firmly believes that the field of high pressure distribution has been definitely determined and its application limited, if not now, it will be in the very near future, to suburban districts and such widely scattered territory where a low pressure system would be prohibitive in cost, where growth is not rapid, and a higher price can be charged for gas.

Where high pressure feeders are in use to feed outlying territory contingent to cities and also are used to boost up weak places along the line, the low pressure system should be extended to relieve the high pressure feeders as the intervening territory fills up, and by so doing keep the installation of compressors as small as possible consistent with the development of a given community.

Let us take, for example, a city or town which has outgrown the low pressure system, a town which is alive and will keep on growing and it needs a new main feeder or feeders. Figure out the cost of low pressure mains, then of equivalent high pressure mains, say 20 lb. pressure, feeding in at every intersection, which it must do to be the exact equivalent of the low pressure. This means manhole and regulator at each. Add to this the cost of the compressor plant and you will find there is not a great margin in favor of the high pressure except that the pressure can be raised and capacity thereby increased. Then we must consider the fact that the high pressure requires constant care and attention, not only for the compressors, but the regulators as well. Looking at it from the point of view of the bond or stockholder, I would rather have my money invested in cast-iron pipe, assuming its life to be fifty years, whose maintenance is practically nil, than in an installation of reciprocating machinery such as compressors in conjunction with wrought iron or steel pipe. The life of the pipe depends upon the reliability of the man who does the coating. The life of a compressor at highest efficiency is not over fifteen years, and as they must be overhauled at least once a year and have a high maintenance cost. Carelessness on the part of the operator may badly damage or completely wreck a machine.

In these arguments favoring the ultimate economy of the low pressure system the writer is not ignorant of the fact that high pressure has bridged over many financial difficulties for gas companies, but it is a toll bridge and not built of sufficiently durable material to withstand heavy traffic.

There is in this connection a matter to be considered which will be an important element favoring low pressure in the future development of the gas business. The present tendency of political development in our states and cities is toward regulation of public service corporations. Those who have watched the working of the public service commission of New York have no doubt observed the trend of events. There is little doubt that a similar commission will eventually exist in all the states. By the regulation of such a commission a corporation is allowed to earn interest on or issue securities covering actual investment only. Such rules will work against the system with cheaper first cost but higher operating expense.

Economy of Operation.

This whole subject might be summed up in the following expression: "Know what your plant is doing at all times, and as well know the condition of your plant while doing it."

This is a rather inclusive statement and means first that a works should have a full equipment of apparatus for recording and making observations beginning with the photometer and gas analysis set and including all of ordinary indicating instruments, such as thermometers and U gauges between scrubbers, at each side of exhauster, and other important points throughout the works, oil and steam nozzle gauges on generators, recording gauges in superintendent's office connected to each generator, etc. The writer has never seen a gas works with too many such devices installed. These instruments are, however, of no use unless properly cared for and kept in working order, any more than is a station meter which is not tested often enough to be kept accurate.

After considering the equipment as above, then there remain the many odd little leaks, small individually, but having in the total a marked effect on the economy of the plant, such as small leaks in steam lines, valve stems, or long runs of steam line to idle equipment with no main cut-out valve, leaky stuffing box glands on engines, compressors, pumps, etc. Holder carriage rollers should be oiled and an inspection of holder cups made during the dry season to keep them filled and prevent blowing (this is a slight compensation to our Eastern brethren who have to prevent freezing in the winter). Some plants shut down their boilers too often on account of poor water when a proper chemical treatment to suit the given condition or even filtration where sand or grit is present would effect an appreciable saving.

The fact is the possible economies in a gas works are as many and as varied as the parts that go into its making, and are limited only by the care and resourcefulness of the man in charge, which brings us to what is really the biggest and most important factor in the economy of a gas plant—the personal one.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.
DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Popularizing Electricity

A soft answer may turn away wrath but it takes hard facts to destroy it. How can an electric company expect to establish friendly relations with its patrons by tact and courtesy when the public knows so little about what they are buying? Confidence and ignorance are never chums. The first essential is to educate the layman, to introduce scientific terms into the vernacular so that the buyer and seller may speak in the same language.

That the layman is eager to learn is attested by the increased demand for books and articles on popular science. Yet the jokes in books are not half as funny as when told on the stage; so likewise it is necessary to talk directly to the people to make them understand how electricity is produced and what it will do. Just as the clown is the smartest man in a circus, so it requires the most brilliant minds to explain scientific matters simply. In these respects, at least, science and humor are akin.

During the past summer a number of electrical manufacturers employed a college professor to roam around their works, just as does a "business doctor" who is sometimes called in to diagnose and prescribe for business failure. But this professor's mission was somewhat different. He simply talked with the men, encouraged them to ask questions and explained in simple language the scientific principles underlying the work they were doing. The companies considered the investment so good that they plan to repeat it at frequent intervals in the future. This professor possessed the rare faculty of popularizing science, of making technical matters clear to the common people. He taught the rudiments of a new language.

True it is that they learn only a sort of pidgin English, a makeshift that has little scientific use insomuch as what is gained by generalities is lost in definiteness. An English translation seldom does justice to a German original, for certain beauties of language are lost in the interpretation just as power is lost in transforming a high voltage current to one of lower potential. The petrographer uses a high power microscope to examine rocks but a cheap magnifying glass suffices for the prospector, giving a larger field but smaller resolving power. We do not use a thirteen inch gun to shoot rabbits, nor is it necessary that the layman be equipped with the ammunition of the scientist to gain a general knowledge of electricity. But if he be supplied with an elementary knowledge he can be brought to a sympathetic appreciation of the wonders of electricity and if he so desires may even use it as a skeleton key to unlock the more intricate subjects.

All employees of electrical companies should be well informed regarding the elementary principles of electricity and be ready at all times to explain them to consumers. A small pamphlet explaining the meaning of a watt, a volt and an ampere and showing how they are measured, as well as giving directions for reading meters would be a good investment if given general distribution. Illustrated lectures and simple experiments at schools, church, clubs and other organizations, sow the seed of confidence broadcast, and not only dispel the prejudice due to ignorance but also establishes the desired amicable relations with the public.

PERSONALS.

R. S. Masson was at Los Angeles during the past week.

Frank G. Drum, president of the Pacific Gas & Electric Company, recently returned from New York City.

W. G. Vincent, Jr., who spent the past six weeks at Los Angeles on electrical engineering work, has returned to San Francisco.

E. C. Bradley, vice-president and general manager of the Pacific Telephone & Telegraph Company, returned last week from an Eastern trip.

Clarence Follis, formerly connected with the Brooks-Follis Company who is now a resident of New York City, has been renewing old friends at San Francisco and vicinity during the past week or two.

G. W. Rounds, formerly general superintendent of the Savannah Electric Company, of Savannah, Ga., has been appointed general superintendent of the Tacoma Railway & Power Company, of Tacoma, Wash.

B. C. Carroll, general agent and George B. Bush, general commercial superintendent of the Pacific Telephone & Telegraph Company, are making an inspection tour of the Pacific Northwest via Seattle and Spokane, Wash.

H. H. Noble, president of the Northern California Power Company, consolidated, has returned to San Francisco after a trip to the new plant at Coleman, which will add about 20,000 h.p. to the capacity of the system within a few months.

John F. Dostal, superintendent of the electric department of the Denver Gas & Electric Company was elected Jupiter at the Birmingham, Ala., convention of the Rejuvenated Sons of Jove. Denver, Colorado, will be the meeting place for the 1911 convention.

John W. Gilkyson has been appointed division commercial superintendent of the Pacific Telephone & Telegraph Company with headquarters at Los Angeles, vice C. M. Seeley. The appointment becomes effective November 1. Mr. Gilkyson was formerly division superintendent of plant at Los Angeles.

Le Roy P. Sawyer, president of the Buckeye Electric Co., and vice-president of the National Electric Lamp Association, is visiting the Pacific Coast, ostensibly on pleasure, but in

Le Roy P. Sawyer

reality transacting much business. From Denver he went to Los Angeles and after visiting Catalina, Pasadena and Del Monte, he reached San Francisco last week. Here he spent most of his time with Andrew Carrigan, of Dunham, Carrigan & Hayden, who are Pacific Coast distributers of the Buckeye lamps. Mr. and Mrs. Sawyer were royally entertained during their visit and left for Portland and Seattle this week with a favorable impression of California hospitality, Mr. J. A. Vandergrift, manager of the Oakland Warehouse, the distributing center for National Electric Lamp Association lamps participating largely in producing this impression. Mr. Sawyer is particularly enthusiastic regarding the engineering department of the Association which has already attracted many engineers and is making special inducements to recent college graduates, particularly Western men.

NEW CATALOGUES.

Bulletin No. 125 from Crocker-Wheeler Co. illustrates and describes the construction of Remek type transformer for light and power.

The General Electric Company recently issued Bulletin No. 4773, entitled "Thomson High Torque Induction Test Meter, Type IB-4."

Bulletin No. 123 from Crocker-Wheeler Co. illustrates and describes the application of Form D direct current motors and generators, 25 to 300 horsepower.

The General Electric Company has superseded its old bulletin on "Centrifugal Air Compressors for Industrial Air Blast and Exhauster Service," by Bulletin No. 4774.

The Waverly Electrics for 1911 are attractively described in a handsome brochure from the Waverly Company, Indianapolis, Indiana. Typographically and mechanically it is a beautiful exemplification of the printing art and brings out to excellent advantage the good points of this machine.

Bulletin No. 120 from the Crocker-Wheeler Company, is devoted to their Form I belt type direct current motors, 3¾ to 50 horsepower. These are particularly applicable to machine tools, pumps, printing presses, laundry machinery, hoists, etc. Form IF and Form L motors designed for closer speed adjustment, are described in Bulletin No. 123.

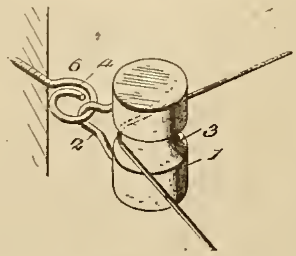
The Insulator Book from the Locke Insulator Mfg. Co., represented on the Pacific Coast by Pierson, Roeding & Co., is one of the most valuable catalogues ever issued upon this subject, containing much data on pole and tower line construction, arranged in a loose leaf binder. The sections on insulator testing are illustrated from photographs and drawings showing apparatus used, including a 300,000 electrostatic voltmeter.

Modern Street Lighting by Luminous Arc Lamps is the title of an attractive booklet just issued by the General Electric Company which is devoted to the suject of street lighting by the General Electric series luminous arc rectifier system. The vertical carbon flame arc lamp is illustrated and briefly described. The station equipment required for this system is mentioned, and a list of cities in which the system has been installed is given. The number of the publication is B-3014.

Bulletin No. 1020, describing magneto non-multiple switchboards of the No. 1800 sectional unit type, has just been published by the Western Electric Company. The bulletin, which is illustrated with many photographs, contains a detailed description of the line circuit apparatus, paying attention both to combined jacks and signals and the line drops. A list of the apparatus required. with different varieties of cord circuits, is given, and other sections are devoted to a description of the operator's telephone circuit and its apparatus, the ringing and night alarm circuit and apparatus, wiring and cabling and line terminal arrangement. The switchboard units are described, as well as methods of assembling these units.

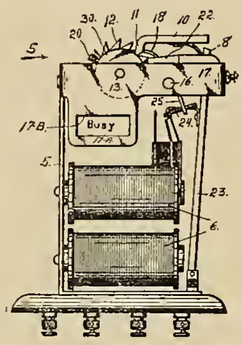
PATENTS

973,409. **Insulated Hanger.** Edward Crabbe, Seattle, Wash. A hanger or support for electric wires comprising a block having a circumferential groove, a yoke projecting from



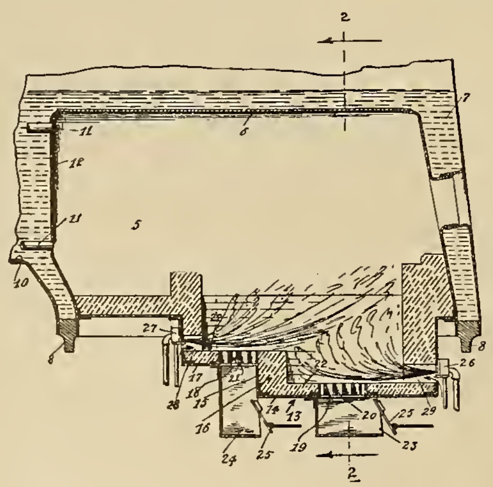
said block and spanning said groove, and a support having an involute spiral with which said yoke is designed to engage.

972,988. **Indicating Means for Party-Line Telephones.** James H. Blythe, Denver, Colo. An indicating means for party line telephones consisting of an indicating plate, a disk



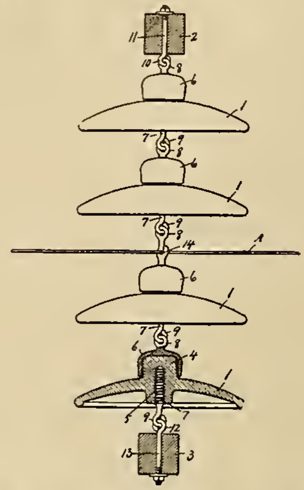
having a cam recess on the face of the inner periphery of the disk, suitable means for actuating said disk, and means for limiting the movement of said disk for the purpose set forth.

973,110. **Oil-Burning Steam-Boiler.** Charles A. Hammel, Los Angeles, Cal. The combination with a steam boiler having a firebox, of means for delivering hydrocarbon flames from the front and rear of the firebox toward each other into the firebox, means for establishing a draft of air into the



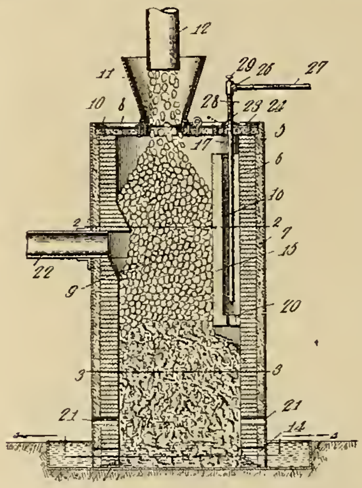
firebox adjacent the flame delivery means, a plurality of means for admitting air directly into the firebox below the flames, one of said means for each burner flame, and means located beneath each of said air admission means for controlling the volume of air to said admission means.

973,204. **Insulating System for High-Potential Electric Conductors.** Fred M. Locke, Victor, N. Y., assignor to The Locke Insulator Manufacturing Company, Victor, N. Y. A system of insulation for high poteltial electric conductors comprising a series of insulators arranged in superposed sequence some distance apart, supports at opposite



ends of the series, connections between the supports and adjacent insulators whereby the insulators may turn with respect to the supports, separate connections between adjacent ends of the insulators whereby each insulator is free to turn, and a seat for a conductor on one of the last named connections and between the supports.

972,864. **Method of Producing Gas.** Edmund G. Jewett, Bellingham, Wash. A method of producing gas which consists in blasting a bed of fuel to incandescence, and simultaneously distilling a superposed body of fuel, and carrying the distilled and separated matter successively into contact with an excess of oxygen, to burn the same and then injecting said hot products of combustion by a steam blast, into the incandescent body of fuel from which the distilled matter



has been previously expelled, whereby substantially complete combustion of the said distilled and separated matter is first effected, and the products of said combustion, together with the excess oxygen are injected into said incandescent body of fuel, the combustion of the distilled and separated matter taking place in a chamber inclosed by and communicating at its opposite ends with the chamber containing the incandescent bed of fuel.

INDUSTRIAL

COMBINATION FUSE AND SERVICE BOXES WITH INTERCHANGEABLE FITTINGS.

The Johns-Pratt Company, of Hartford, Conn., through their sole selling agents, the H. W. Johns-Manville Company of New York, has recently placed on the market a large and complete line of Noark fuse and service boxes. of both weatherproof and water-tight types. These various boxes and fittings have been given approval by the Underwriters' Laboratories, and consist of boxes for 250 and 600 volts, all capacities, for two and three-wire systems and accommodate Noark enclosed fuses of the national standard types.

Figs. 1 and 2 show construction of water-tight boxes which may be used for house service work, as well as aerial and subway work in connection with iron pipe conduit, and

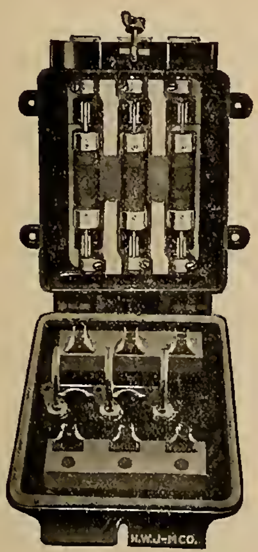


Fig. 1.

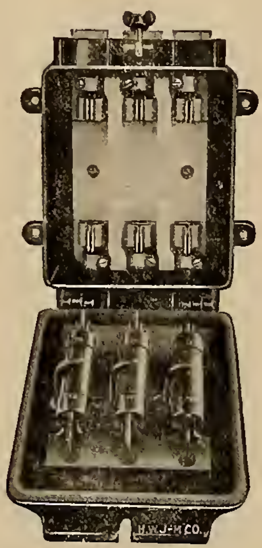


Fig. 2.

where used for subway work, cable sleeves may be inserted into the various types of interchangeable conduit fittings for the purpose of making wiped joints on lead covered cables.

Fig. 1 shows the fuses in circuit, and Fig. 2 illustrates fuses withdrawn from the circuit by means of a handle on the outside of the cover which simultaneously actuates three fuse carrier hooks within the box, thus withdrawing the fuses and performing the function of a switch.

Each end of Noark fuse and service boxes is provided with a large oval box having a machine surface which is drilled and tapped to accommodate various types of fittings and the porcelain bushings extending therefrom are fastened in the box with soft lead washers, forced into place under heavy pressure, which permanently holds them in position.

The larger sizes of these boxes are provided with galvanized chains to prevent the hinges from becoming broken from careless manipulation. All boxes are provided with sealing arrangements.

THE WONDERS OF THE WESTERN ELECTRIC.

According to Herbert N. Casson in the Telephone Review the Western Electric Company is an immense aggregation of workshops in which have been made three-fifths of the telephone apparatus of the world. The mother-factory of this globe-trotting business is the biggest thing in the spacious back-yard of Chicago; and there are eleven child-factories scattered over the earth from New York to Tokio. To put its totals into a sentence, it is an enterprise of 26,000 man-power, and 70,000,000 dollar-power; and the telephonic goods that it produces in half a day are worth $100,000—as much, by the way, as the Western Union refused to pay for the Bell patents in 1877.

The Western Electric was born in Chicago, in the ashes of the big fire of 1871; and it has grown up to its present greatness quietly, without celebrating its birthdays. At first, it had no telephones to make. None had been invented, so it made telegraphic apparatus, burglar alarms, electric pens and other such things. But in 1878, when the Western Union made its short-lived attempt to compete with the Bell Company, the Western Electric agreed to make its telephones. Three years later, when the brief spasm of competition was ended, the Western Electric was taken in hand by the Bell people, and has since then remained the great workshop of the telephone.

The main plant in Chicago is not especially remarkable, from a manufacturing point of view. Here are the inevitable lumber yards and foundries and machine shops. Here is the mad waltz of the spindles that whirl silk and cotton threads around the copper wires, very similar to what may be seen in any braid factory. Here electric lamps are made, 5000 of them in a day, in the same manner as elsewhere, except that here they are so small and dainty as to seem designed for fairy palaces.

The things that are done with wire in the Western Electric factories are too many for any mere outsider to remember. Some wire is wrapped with paper tape at a speed of 9000 miles a day. Some is fashioned into fantastic shapes that look like absurd sea-monsters, but which is reality are only the nerve-systems of switchboards. And some is twisted into cables by means of a dozen whirling "drums"—a dizzying sight, as each pair of "drums" revolves in opposite directions. Because of the fact that a cable's inveterate enemy is moisture, each cable is wound on an immense spool and rolled into an oven until it is as dry as a cinder. Then it is put into a strait-jacket of lead pipe, sealed at both ends and trundled into a waiting freight car.

No other company uses as much wire and hard rubber or as many tons of brass rods as the Western Electric. Of platinum, too, which is more expensive than gold, it uses 1000 pounds a year in the making of telephone transmitters. This, of course, is imported from the Ural Mountains. The silk thread comes from Italy and Japan. The iron for magnets comes from Norway, the paper tape from Manila, the mahogany from South America, and the rubber from Brazil and the valley of the Congo. At least seven countries must cooperate to make a telephone message possible.

Perhaps the most extraordinary feature in the Western Electric factories is the multitude of its inspectors. No other sort of manufacturing, not even a government navy-yard, has so many. Nothing is too small to escape these sleuths of inspection. They test every tiny disc of mica, and throw away nine out of ten. They test every telephone by actual talk; set up every switchboard and try out every cable. A single transmitter, by the time it is completed, has had to pass 300 examinations; and a single coin-box is obliged to count 10,000 nickels before it graduates into the outer world. Seven hundred inspectors are on guard in the two main plants at Chicago and New York.

TRADE NOTE.

The General Electric Company has sold to the Atchison, Topeka & Santa Fe Railway Company two A. T. B. 2, 100-kw., 3600-r.p.m., 400-v., a.c., non-condensing Curtis steam turbines, with direct-connected exciters The new equipment is to be installed at Barstow, Cal., where the Santa Fe has repair shops.

THE ELECTRIC VEHICLE BATTERY[1]

BY BRUCE FORD.

Although primary batteries have been used to a small extent experimentally as the motive power of electric vehicles, the storage battery is the recognized standard for this purpose. Storage batteries may be divided into two classes according to the nature of their electrolytes; first, that having an acid solution; second, that having an alkaline solution.. Neutral salt solutions although employed to a large extent in primary batteries have never been used successfully in storage batteries. Where alkaline solutions have been employed the electrolyte has invariably been a solution of caustic potash. The electrodes used with the alkaline solution have been various metals and oxides, such as copper, silver, nickel or cobalt in the positive pole electrode, and zinc, cadmium or iron in the negative pole electrode. In some batteries of this class metals are permitted to go into solution, although such batteries are not now being commercially exploited, and the alkali batteries of today are constructed with insoluble materials in both electrodes. The Edison and Jungner batteries are the most familiar examples of this type.

In the acid battery, although various solutions have been proposed and tried, dilute sulphuric acid is the recognized commercial standard for an electrolyte. Soluble electrodes, although at one time considerably exploited, have been abandoned in favor of insoluble electrodes, and the recognized standard material in both positive and negative plates is now lead. The lead cell is the oldest commercial form of storage battery, dating back to 1860. Although the principlies involved in the lead-sulphuric acid battery are the same as when it was originally brought out, yet the methods and results obtained have been the outcome of exhaustive experiments, some of which are still in progress, while many new experimental lines are being continually developed. The lead-sulphuric acid battery has characteristics of high and uniform individual cell voltage on discharge combined with low internal resistance and high watt-hour efficiency which render this type of cell peculiarly adapted to the needs of electric vehicle propulsion where high currents are required for acceleration, hill climbing and bursts of speed. The nickel-aliki-iron battery has a high capacity per unit of weight which makes it attractive where an abnormal amount of mileage is required per charge. The manufacturers of this battery also claim a very long life. The battery is new in commercial operation, and therefore no definite commercial figures have been obtained as yet to substantiate this claim. High internal resistance and high initial cost are among its disadvantages.

In the present standard type of lead cell the capacity per pound can be varied within certain limits by furnishing plates of different thicknesses. A thicker plate has a longer life in number of cycles of charge and discharge than a thin plate, but its capacity per pound on each discharge is not so great. The makers of the "Exide" battery have developed commercially several thicknesses of which three will be described as being representative. The standard "Exide" battery has a positive 7-32 in. thick and gives a capacity initially of about 8 1-3 watthours per pound of complete cell at its five hour discharge rate, and this capacity will increase to about 10½ watthours in service. The "Hycap Exide" has a positive plate 3-16 in. thick, will give initially about 9¼ watthours per pound and will work up in service to about 12 watthours per pound of complete cell at the five hour rate of discharge. The thin plate battery has a positive 9-64 in. thick, will give initially about 10 watthours per pound, and will work up in service to about 13¼ watthours per pound of complete cell at the five hour rate of discharge. There are of course more plates per pound of thin plate battery than of thick plate battery. Experience has demonstrated that with a given weight of battery where about the same percentage of the full capacity of the battery can be utilized on each discharge, the life in miles of the thin plate batteries is about the same as that of batteries equipped with the thicker plates. In other words, the extra mileage obtainable on each discharge practically compensates for the reduced number of discharges obtainable during the life of the batteries having the thinner plates.

Experiments have shown that the lead battery is capable of considerable further development to produce higher capacity per unit of weight and also to produce plates of considerably longer life. In both the lead and the nickel types of batteries the action which governs the life is largely mechanical. In the respective processes of charging and discharging the battery, the active material of the positive pole plates becomes alternately oxidized and deozidized. This alternate action causes a molecular disturbance which would eventually cause the active material to lose its coherence unless artificially maintained. In the lead battery it has generally been the practice to permit the active material to become gradually disintegrated and washed out from the surface, and to allow a reserve in the quantity of active material sufficient to produce a commercially satisfactory life. To the carrying around of this reserve active material in the lead battery is largely due to its greater weight per unit of capacity than that of the alkali battery whose active material is maintained mechanically to restrict its molecular disintegration.

For many years experiments have been carried on in this country and abroad to determine what could be done toward preventing the disintegration and washing away of the lead active material. To a Frenchman belongs the credit of having invented the only practical method so far found to actually accomplish this result. The fact was thereby established that by holding the active material in its place the life of the plate can be prolonged with excellent capacity to an almost indefinite period. The mechanical details of construction employed for this purpose were complicated and expensive, and this battery up to the present time has never been exploited to any considerable commercial extent. Recognizing, however, the value of the principle involved, the Electric Storage Battery Company, makers of the "Exide" battery, several years ago secured the American patent rights to this type of cell, and since then have been carrying on a course of experiments with most encouraging results, so that when they put this battery on the market, which will be within a very short time, it will be with every confidence in its future. In its present form this battery will give initially in the neighborhood of 9½ watthours per pound, increasing in use to somewhat over 13, with a life of from two to three times that of the standard lead battery, and during its life the necessity for cleaning the battery of sediment will be eliminated. In the course of the years of experimenting with this battery various means of still further increasing the capacity per unit of weight of the lead cell have been opened up so that a wonderful future may be predicted, not only for the new battery, but for the lead battery as a whole, of which this new battery is only one form.

[1]Paper read at convention National Electric Vehicle Association, New York City, October 14, 1910.

ELECTRIC AUTOMOBILE APPLIANCES.

Bulletin No. 4772, entitled "Electric Automobile Appliances," issued by the General Electric Company, supersedes its previous bulletin on this subject, and illustrates and describes an outfit for charging the storage batteries, as well as a combination ammeter and voltmeter for automobiles. It illustrates Mazda lamps for head-light, side-light and tail-light, and also a lamp for limousine illumination. Automobile motors, controllers and air compressor outfits are illustrated and described.

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—The Oregon Water Power Company has been incorporated by R. B. Candage

OROFINO, IDAHO.—The Orofino Electric Company has been incorporated by K. G. Osterhaut.

REPUBLIC, WASH.—The Kettle Valley Power & Electric Company has been incorporated by Henry B. Russell and Joseph Many for $500,000.

HANFORD, CAL.—The San Joaquin Light & Power Company has been incorporated by W. E. Durfey, E. B. Walthall, A. E. Wishon, A. N. Kemp and L. N. Farnham, with a capital stock of $25,000,000.

SPOKANE, WASH.—The Spokane, Portland & Northern Railway has filed articles for $10,000,000 through E. P. Spalding. The object of the company is to build an electric line from here to Nighthawk, near the international boundary.

AVON, MONT.—The Avon Local Home Telephone Company, capital $10,000, has been incorporated and will at once begin the development of the telephone service in this vicinity. C. G. Mead will have charge of all construction work.

SALEM, ORE.—The Independent Electric Company which has been incorporated in Multnomah county with a capital stock of $100,000 by H. G. Fleischauer, F. Hall and E. Hardy, has completed negotiations for the purchase of the Hillsboro Water, Light & Power Company and the Haines Light & Power Company, which controls a water power plant 16 miles from Forest Grove. The plans of the new company contemplate the expenditure of several hundred thousand dollars for improvements and extensions and consider the extensions of the company's power lines to Beaverton, Orenco, Cornelius, Dilley, Oregon Electric between Beaverton and Forest Grove. R. H. Boykin, who has an office at No. 502 Fenton building, has been made president of the new corporation. The head office of the company will be in Portland.

FINANCIAL.

WHITE SALMON, WASH.—The town of White Salmon will vote on October 29 on the question of issuing bonds in the sum of $7500 to pay off its indebtedness.

WALLACE, IDAHO.—The North Idaho Telephone Company, a local corporation operating in the Coeur d'Alene has been authorized by the board of directors to issue bonds for $50,000 for the purpose of making extensions.

VALLEJO, CAL.—The bond issue of $90,000 recently voted by the people of Vallejo for the purpose of constructing an additional distributing reservoir at Fleming Hill, a few miles from this city, as well as for installing new mains, has been declared valid, the city trustees having submitted the bonds to the firm of Goodfellow, Eels and Orrick of San Francisco. This step was taken as a precaution before calling for bids. Bids for the bonds will be opened on November 16.

LOS ANGELES, CAL.—The Los Angeles Railway Company has increased its capitalization from $5,000,000 to $20,000,000 and changed the last word of its name to "corporation." Howard E. Huntington, general manager, is the principal subscriber, his shares representing all but $6000. His father and others hold the remainder. Great extensions and improvements are to be made with the additional capital. The corporation already operates 240 miles of trackage and this is to be increased by 100 miles within two years.

TRANSMISSION.

FOREST GROVE, ORE.—A. Welch of Portland has been granted a franchise to erect poles and wire for the transmission of power in this city.

FOREST GROVE, ORE.—A. Welch of Portland was granted a franchise by the city to erect and maintain poles and wires along certain streets for the transmission of power and electricity.

LOS ANGELES, CAL.—The Los Angeles Railway Company has petitioned for a franchise through Broadway tunnel so that the Highland Park cars may reach Broadway, reducing the running schedule.

ROSEBURY, IDAHO.—L. A. and N. E. Wayland, who are putting in a power plant at Crawford Falls, have made arrangements with the owners of Tamarack falls site to put in a plant there. A contract has been signed and a stock company is being formed.

OROVILE, CAL.—The Golden State Power Company and the Canton Mining Company, which have been at war over water on the North Fork of the Feather River, have reached a compromise. The Golden State is a sub-company of the Great Western Power Company.

BOZEMAN, MONT.—It is announced that the gas producing plant, which was recently granted a franchise to enter the city, will be erected this fall. Users will be supplied before January 1st. Senator J. C. McCarthy and Chicago capitalists are interested; the cost of installing the plant is approximately $100,000.

REDDING, CAL.—A suit for riparian water rights has been filed by 21 farmers living on Hat creek and Lost creek against the Sacramento Valley Power Company and the Shasta Power Company, which have virtually merged. The farmers contend that their land is being rendered worthless from lack of water for irrigation purposes. It being stated that two dams built by the power companies in the two streams divert 3000 miner's inches of water from each under a four-inch pressure. According to the complaint, there is little water left for domestic purposes after the power companies have diverted what they wish for the generation of electrical current.

REDDING, CAL.—A tunnel 6½ miles long, for conveying water from Pit River to Montgomery creek, is being constructed by the Mt. Shasta Power Company, an organization formed of Eastern capitalists under the direction of Harry Hatfield who has headquarters in San Francisco. A large force of drillers and diggers are at work at both ends of the tunnel, progress of 200 feet having been made at the east end and 150 feet at the west end, it being estimated that the time required to complete the tunnel will be 18 or 20 months. Air drills are being used. The fall of the water from the place of its entrance to the tunnel outlet will be 800 feet.

MANTON, CAL.—J. G. Cochrane, the engineer in charge of the work which is being done by the Northern California Power Company, at Eagle Camp on North Battle creek, three miles below Manton says that the construction work will be completed this week. A dam 65 feet wide and 10 feet high has been constructed. A total of 1325 feet of tunneling has been drilled within a mile. There are six of the tunnels, being respectively 100 feet, 110 feet, 390 feet, 160 feet, 391 feet and 165 feet in length. There is 3674 feet of flumes carrying 2000 inches of water which will empty into Inskip ditch for the purpose of generating power at the Inskip power house, 2½ miles below. This work has been accomplished during the past five months.

TRANSPORTATION.

LOS ANGELES, CAL.—The Pacific Electric Railway Company will extend its new La Habra line beyond Yerba Linda.

MARYSVILLE, CAL.—The City Council has passed the franchise asked for by the Northern Electric Company to lay a line of track across F street.

SEATTLE, WASH.—The Puget Sound Electric Company is constructing new cars for the Seattle-Tacoma run, and expects to have the same in operation by December 1st.

MARYSVILLE, CAL.—The sale of Armory hall to the Northern Electric Railway means the tearing down of that building and the erection on the site of a freight and passenger depot.

OAKLAND, CAL.—The Southern Pacific Railroad Company will next month electrify its Seventh street line here. It is estimated that the company will spend about $200,000 on street paving, exclusive of the cost of straightening the street.

SEATTLE, WASH.—The Seattle-Tacoma Short Line has started construction work on the proposed line. Clearing of right of way has started near Youngstown. James P. Murphy, president, states that the line will be in operation in about two years.

MEDFORD, ORE.—Work will begin in two weeks on the Rogue Valley Interurban, the electric road to be built between Ashland through Medford, to Grants Pass. Resident Engineer W. W. Harmon of the Pacific and Eastern Railroad, will take full charge of the construction of the new electric line.

STOCKTON, CAL.—The Tidewater and Southern Railroad Company, known as the Stockton-Turlock road, announces that it will be operating cars between Stockton and French Camp by December 15. The electric road will use the roadbed of the old Corral Hollow steam line running out of Stockton to a point near French Camp. The company will begin grading November 1.

RENO, NEV.—The city council recently cited the Reno Traction Company to appear and show cause why its franchise for street railway service in Reno should not be revoked. The company failed to obey the citation whereupon the council has ordered the city attorney to institute proceedings to cancel the franchise and have the street car lines sold to pay the expenses of the proceedings. The company will protect itself by litigation.

SAN FRANCISCO, CAL.—Since the recent completion of the second pole line of the Sierra & San Francisco Power Company from the hydroelectric plant on the Stanislaus river to San Francisco, the United Railroads has shut down the engines at both of its steam power plants. The load is being satisfactorily taken care of by the transmission lines. Steam is kept up at the North Beach power station so that power could be furnished promptly in case of emergency.

SACRAMENTO, CAL.—If the plans of the car employes of the Central California Traction Company and members of the Sacramento Carmen's Union, composed of employes of the Sacramento Electric, Gas & Railway Company, are carried out, the traction company men will join the local union. The new company is running "open shop." It is announced that in organizing the traction men will do so with the end in view of consolidating with the local union. This action would make the carmen's union one of the strongest in the city.

ILLUMINATION.

CENTRALIA, WASH.—The city of Centralia is now in the market for the purchase of equipment of a municipal lighting plant.

ORANGE, CAL.—The Orange County Gas Company denies that it has disposed of its holdings in Orange and Anaheim to a Los Angeles corporation.

CHEHALIS, WASH.—It is understood that the Twin City Light and Traction Company has succeeded in floating bonds to the amount of $150,000, the funds to be used in erecting a new power house and other improvements.

REDMOND, ORE.—The Crook County Water, Light & Power Company of Redmond, Ore., has purchased the Cline Falls Power Company's holdings; price is given at $55,000. An additional plant will be installed soon.

SANTA BARBARA, CAL.—The Santa Barbara Gas & Electric Company will start work immediately for a high tension 10,000-volt line from its power station on Castillo street, to a sub-station in Montecito, which will cost $10,000, and will also build a concrete station house.

COLUSA, CAL.—W. M. Henderson, local manager of the Pacific Gas and Electric Company, announces that the company will commence the construction of a steel building to be used as a boiler and engine room. The building will be 50x27 feet and will cost $4000. The electric system is to be overhauled and improved at an expense of $3000, this work is also to be commenced on November 1.

UKIAH, CAL.—Sealed bids will be received by the Board of Trustees up to 8 p. m., December 5th, for the sale of a franchise to erect, maintain and operate a gas generating plant for the manufacture, sale and distribution of fuel gas and gas to be used for fuel and heating purposes, to lay and construct pipe lines in, along, through and under all of the alleys, streets and avenues in the city of Ukiah, which has been applied for by the Ukiah Gas. Company.

BISBEE, ARIZ.—The Los Angeles Trust Company of Los Angeles has filed suit at Tombstone demanding a receiver for the Bisbee Light & Power Company, the only gas manufacturing concern in Bisbee. The International Gas Light Company, the Michigan Trust Company of Detroit, Mich., and W. H. Goode of Los Angeles are mentioned for the appointment of the receivership. The International issued $40,000 in bonds and after becoming the Bisbee Light & Power Company, the concern issued $200,000 in bonds. The Michigan company is the trustee for the bondholders who purchased the Bisbee Light & Power Co.'s bonds. W. H. Goode has a $4000 judgment against the company. The interest on bonds has defaulted. The assets of the company are placed at $75,000 and its bonded indebtedness at $244,000.

TELEPHONE AND TELEGRAPH.

SANTA ROSA, CAL.—With the completion of arrangements for the issuance of $300,000 bonds by the Clear Lake Consolidated Telephone Co., a big merger of telephone lines has been effected. This company, recently organized, has taken over all the properties, rights and franchises of the Clear Lake Telephone and Telegraph Company, operating lines in Lake, Mendocino and Napa counties, the Northwestern Telephone & Telegraph Company, operating exchanges and lines in the Sonoma Valley, along Russian River and other points in this county; the Gold Ridge Improvement Company, operating lines in the Gold Ridge section of this county, and the plant of the Northwestern Electric Company. The systems are connected with the main system at Ukiah, Cloverdale, Santa Rosa, Sonoma, Sebastopol and other points. A. H. Spurr is the president and Fred L. Wright of this city is the secretary and general manager.

WATERWORKS.

TACOMA, WASH.—A contract for the work of laying a new water system for the tide flats was awarded by the commissioners to P. E. McHugh at $49,190.

BELLINGHAM, WASH.—The contract of the city with the Larson Lumber Company for pumping water from Lake Whatcom to supply Silver Beach and other territory adjacent has been signed by the representatives of both the city and the lumber company and is now in effect.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 19 | SAN FRANCISCO, NOVEMBER 5, 1910 | PER COPY, 10 CENTS

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VOLUME XXV | SAN FRANCISCO, NOVEMBER 5, 1910. | NUMBER 19

POWER FOR PUMPING CALIFORNIA OIL

The announcement that the San Joaquin Light & Power Company recently contracted with one oil company for 2500 kw. to be used exclusively for pumping oil emphasizes the fact that a great amount of power is required to pump the fifty million barrels, and more of oil that are annually produced by California. There are about five thousand producing wells in the State, each one requiring about a 20 h.p. installation, a total of one hundred thousand horsepower, exclusive of the power required for drilling.

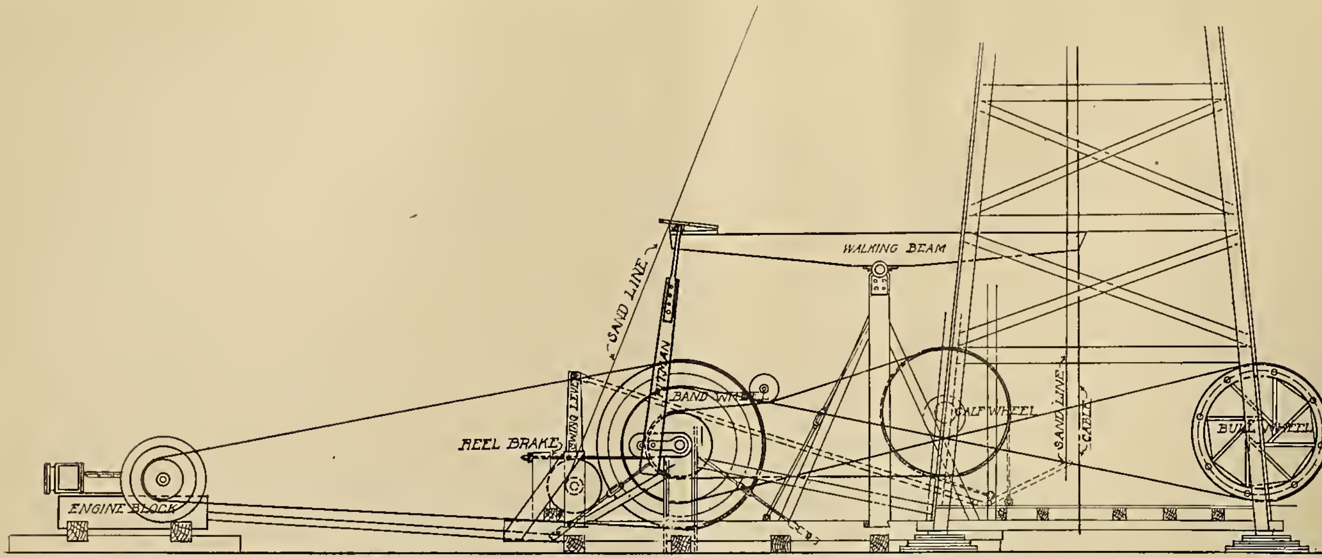
Oil Pumping Rigs in Coalinga Field.

Heretofore power has been mostly supplied by steam plants, though gas engines are used wherever natural gas is available and electric motors are being rapidly introduced and bid fair to soon take the first place. This substitution is being accomplished by the adaptation of the three-phase induction motor to the peculiar speed condition and load variations required in this work, the details of which will herein be developed after a brief description of the steam practice employed.

The accompanying view shows nearly two hundred wells in the Coalinga field. Close inspection will show that the nucleus of each cluster, which represents a lease, is a steam boiler plant which supplies steam to the surrounding pumping engines. The usual equipment consists of three 80 h.p. return tubular boilers with feed water heater and purifier. Oil is ordinarily burned as fuel though there are many plants burning natural gas.

Water suitable for boiler use is scarce and some wells originally sunk in search of oil, but now producing water, are netting their owners a good income, in cases as high as $50 per month per oil well supplied. Even this water must be purified and causes much trouble with scale, foaming and corrosion. A feedwater heater and purifier is almost indispensible at most plants, but there yet remains a wide field for improving water conditions.

Pipe lines varying in length from 50 to 2500 feet convey the steam from the boilers to the engines at the wells. Although these pipes are well insulated with asbestos and oil sand and buried in the ground, there is a large loss due to condensation. The water in the steam gives much trouble in operating the engines and the entire efficiency of the system is low.



Sketch of Oil Pumping Rig.

Steam Pumping.

The engines are of the non-condensing reciprocating type and rated at from 13 to 30 h.p., according to the depth of the well. As may be seen by the accompanying sketch the engine is belted to a band wheel which operates a walking beam to which a string of steel rods is attached, the rods being 20 ft. long and varying from 3/4 to 7/8 in. in diameter. The rods in turn actuate a single action plunger pump at the bottom of the well, the pump consisting of a plain working barrel with a ball valve at the bottom and

A Flowing Well and Unused Pumping Rig.

a single valve in the plunger. A short stroke is used in pumping, quick on the down motion and slow on the up, the beam being adjusted to keep the oil at the desired level in the casing. Because of the liability of the pump becoming clogged with sand, constant watchfulness is necessary on the part of the operator to provide a proper pumping speed.

If the pump does become sanded, it is necessary to "pull" the casing and rods in order to get at the seat of the trouble' This is a heavy job that severely taxes the capacity of the engine and occasionally even collapses the derrick.

Gas Pumping.

Where natural gas occurs, many companies are now pumping with gas engines. Owing to the lower cost of gas these plants are operated as cheaply as can be desired, though the first cost is greater than an electric motor and the gas engine is proverbially unreliable, often failing when most needed. The cost of lubrication is also high, experience showing that oftentimes the lubricating oil alone costs as much as does the electric power necessary to operate an equal capacity in motors. There is also present the constant menace that the gas supply may fail at any time. These factors however are not serious enough to deter those fortunate enough to have a gas supply from utilizing it as long as it proves available.

Electric Pumping.

A special adaptation of the three-phase induction motor has recently been devised so that it now meets the peculiar and exacting requirements of oil pumping. This, combined with the fact that electric power is now being distributed throughout many of the fields, particularly those within the radius of the San Joaquin Light & Power Company, is causing the rapid substitution of electric power for the older methods. The leading manufacturers of electric motors have conducted a long series of tests to adapt their machines to this use and as a result of their successful issue are now taking contracts for installation.

The motor employed is of the polyphase induction type with form wound rotor, having three collector rings and external controller and resistance. Variable speed is obtained by varying the external resistance in the rotor circuit by a cylinder controller much like that used in street car service. One recent test showed that the stroke of the pump can thus be varied from 15 to 27 per minute as required and also that the down stroke was much faster than the up, the motor speed varying from 210 to 470 r.p.m. when pumping 15.2 strokes per minute to from 495 to 625 r.p.m. when pumping 26 strokes per minute. The motors may be either back-geared or belted to a counter shaft and thence belted to the band-wheel.

The actual horsepower required for pumping varies from 5 to 8, and for pulling out rods and tubing from 30 to 50, depending upon the depth of the well. The most practical installation is a motor that will take care of both pumping and cleaning, a requirement met by the Y-delta motor. With line voltage of 440 and motor connected in delta full line voltage is impressed on the coils of the motor. If the motor coils are Y-connected the voltage on each coil is 57.7 per cent of the line voltage or 254 volts. As the torque of a motor varies approximately as the square of the voltage a 440 volt delta connected 20 h.p. motor gives 6.67 h.p., when Y-connected ($440^2:254^2 = 20:6.67$). The power factor and efficiency is practically the same when running at full load on the Y-connection as when running full load on the delta-connection, the control apparatus having the same effect in either case. The change from Y to delta connection is accomplished by the use of a triple pole, double throw switch usually mounted on the motor frame. The same method of speed control applies for both connections, the operating handle turning in two positions to allow for reversing the motor.

The advantages of the electric motor as compared with both steam and gas are its low initial cost and its cheapness of operation. Its economy and its convenience make it the ideal power. The annual repairs for a motor is less than 5 per cent of its cost, while those on a steam engine are about 9 per cent and a gas engine about 15 per cent. There is no fuel nor water required and the labor charge is much reduced. Its one possible disadvantage is an interruption of service against which every precaution is being taken and for which ample compensation could be provided in the contract for electric service.

SEATTLE ELECTRIC COMPANY'S STUDENT COURSE.

Acting upon a suggestion by S. C. Lindsay, assistant electrical engineer, officials of the Seattle Electric Company have approved of a plan for giving electrical students a practical education in the departments of the Seattle Electric Company.

The object of this course is to develop men to meet the needs of the company in responsible operating positions. The course will be of 2½ years' duration and will consist of training in electrical construction, both station and line work; central station operating, both steam and electrical apparatus; a small amount of meter testing and such office engineering work as conditions permit will also be given.

Applicants who have not had a college training will be required to pass an examination in order to prove their qualifications for entering the course. Examination will be more of a practical than of a technical nature.

All students must be over 21 and under 30 years of age. Persons already in the employ of the company will be given preference when selecting students. Students not already in the employ of the company. and who may be selected from the list of applicants shall receive $50 per month upon entering the course. A record of the students will be kept and their showing in each department reported by the head of the department, so as to determine their fitness for any particular line of work.

THE OIL SITUATION FROM A GAS MAN'S VIEWPOINT.[1]

BY H. W. BURKHARDT.

The existence of alphaltum and semi-solid bitumen has been known in Santa Barbara county since 1792, but no attempt at development was made until about seventy-five years thereafter.

The first well for crude oil, the "Pico Well," was drilled in 1867 near Newhall, Los Angeles county.

In 1872 sufficient oil was struck in Ventura county to justify the erection of a refinery and the piping of the oil to the coast for shipment to San Francisco.

The occurrence of oil in Ventura county lead several individuals to form oil companies with the intention to drill for crude petroleum.

In the City of Los Angeles the first successful well was drilled in 1892. Within the next few years over 700 wells were drilled. Today the City of Los Angeles harbors 450 producing wells with a production of 428,000 barrels for 1909.

Los Angeles County.

Los Angeles county comprises five distinct fields: Los Angeles City, Whittier, Fullerton, Puente and Newhall; with probably another one to be developed in the Santa Monica mountains.

The Los Angeles City field includes Sherman and Salt Lake. The entire field extends toward the coast, and will be a large factor in the oil market for many years to come.

The Whittier field was one of the latest to be developed in Los Angeles county, and is probably not yet fully developed. The wells vary from about 1000 feet to about 4000 and perhaps 2200 feet would be a fair average. The quality of the oil is good and the oil is sought after by refiners and gas works. Much of the product is piped to Los Nietos on the Santa Fe Railroad, and is there loaded into cars for shipment, but practically the entire field lies 700 to 900 feet above the harbor of San Pedro, 18 miles away, thus affording an easy and cheap means of transportation to ship side.

The Santa Fe Railway, associated with others, started work in Fullerton about 1895 and within a short time oil was found in large quantities. Wells in the territory of Fullerton run from 2000 to 4000 feet in depth. Work is still going on in the field and the output is being increased yearly. The Santa Fe Railway and the Hall Company practically control the output of the entire field.

The Puente Oil Company has drilled a large number of wells, most of which have been good producers. The field is still being extended, although there have been some dry holes, and quite a number of the wells on the edge of the field have ceased to yield a remunerative amount. Most of the oil produced in the Puente field goes to the refinery at Chino, to which place there is a six inch pipe line.

Newhall field produces a very high grade oil. Most of the product goes to the Standard Oil Company, being piped to Ventura and from there shipped by steamer to the refinery at Point Richmond.
rapidly increased within the next ten years to such an extent that it is more than likely that by 1920 the Coal-

[1] Paper read before the 18th annual convention of the Pacific Coast Gas Association, September, 1910.

Ventura County.

In Ventura county there has been a steady production of oil for about 36 years, and from present indications, the already large number of wells will be doubled within the next ten years. There have been drilled in Ventura county not less than 500 wells, and it is estimated that of the entire amount more than three-fourths are now producing. There are various reasons why the balance of the wells are non-producers. Some few were dry holes in the first place, others were not drilled deep enough, in many cases tools were lost in the wells, and a few had become exhausted. The oil-bearing sands are found at various depths in the different localities. There is generally a stratum of shale, alternated by a stratum of sand. The water troubles are comparatively small and there is practically no difficulty in shutting-off water from the oil-bearing stratum, when same is encountered. In a part of the Santa Paula canyon no water is encountered.

Of the twelve distinct fields in Ventura county, Santa Paula is now the largest producer. Many new companies have lately gone into the field, and it is more than likely that Santa Paula will stay at the top of the different oil fields in Ventura county.

The transportation facilities are excellent. Most of the producing territory lies at an altitude of from 800 to 1500 feet, at a distance of from three to twelve miles from the railroad, and of from six to thirty miles from the Pacific Coast.

Practically all the oil produced in Ventura county is of light gravity. There is very little oil in the entire district around Santa Paula that runs less than 18.5 degrees Beaume and the entire production will easily average 24 degrees Beaume.

Santa Barbara County.

Santa Barbara contains four separate fields, though it is likely that three of them are connected.

The four fields are: Santa Maria, Gracioso, Lompoc and Summerland.

The Santa Maria is the principal one, and probably Gracioso and the Lompoc fields will be connected with the main field. Summerland is a distinctive field as the oil produced is of an entirely different character.

The wells in the Santa Maria fields are deep and are large producers. Notable is the Hartnell gusher, which has produced over 2,000,000 barrels of oil. The Palmer well is at this time producing some 6000 or 7000 barrels of oil daily, and is actually producing more oil than can be handled, owing to insufficient transportation facilities.

Considerable new work is being done and the field is being extended both to the east and north.

Many of the wells are producing water and an unfortunate feature of this water trouble is that the oil is produced from shale rather than from sand. The water has a tendency to slake the shale, thereby precipitating some of its constituents and forming an emulsion with the oil. There is no serious trouble in separating the water from the oil, but the sludge or emulsion thus formed cannot be entirely separated, and leaves a certain percentage of sediment in the oil that it is well nigh impossible to separate therefrom by any process thus far evolved. This sediment amounts in some cases to as much as 4 per cent and can neither be refined nor burned. It is possible that some means will be found of separating this material from the oil in the future, but so far it has not been accomplished. It has been a very serious matter with some of the older companies operating in the Santa Maria field.

This emulsion must not be confounded with the sludge formed in testing crude oil for water by the gasoline method. Gasoline when mixed with any oil of an asphaltum base separates in a spongy form, being in reality a flaky brown substance called sludge. This is asphaltene which normally remains dissolved in oil and which has practically the same value for fuel and gas manufacture as any other part of the crude oil.

In the greater part of this field the oil is of light gravity, except in the eastern portion where the Palmer gusher produces oil of 14 degrees Beaume. The development of the field has been rapid, considering the difficulties encountered in drilling, and there are now something like 170 completed wells with a production of about 11,000,000 barrels per year, and the field is being constantly enlarged by the discovery of new wells, both to the south and east.

At Summerland about 350 wells have been drilled belonging to some 40 companies. There never was a time when the production of the field averaged ten barrels per well. The greatest amount produced in any one year was 208,370 barrels in 1899, since which time the production has gradually decreased until at the present time it is not in excess of 65,000 barrels per year.

The California Liquid Asphalt Company had a refinery at Summerland. The production of the field, however, has fallen so low, that the refinery was moved to another field.

By many geologists it is thought that there is another and more productive sand underlying the Summerland field, but so far no deep drilling has been carried on.

South from Summerland lies Carpenteria. Several wells, at least one of which has attained a depth of over 3000 feet, have been sunk on the low lands near Carpinteria. Oil was found in all of them but in none in commercial quantities.

The gravity of the oil from the Summerland field runs from 13 degrees to 16.5 degrees Beaume, though the gravity of the oil is generally decreasing as the wells produce more and more water.

Fresno County.

The Coalinga field is bearing oil at depths varying from 700 to 3600 feet. The productive area does not cover much more than 100 acres and the most determined efforts have so far failed to extend the field. The oil runs in specific gravity as high as 0.844 and is of a yellowish green fluorescence.

Coalinga has already produced over 50,000,000 barrels of crude oil, and, according to the report of the United States Geological Survey, there are approximately 3,000,000,000 barrels of oil in already proven area. At the present rate of production of about 1,000,000 barrels per month, it would take 300 years to exhaust this vast supply; but the present rate will be

inga field will be producing at least double what it is now. It is, of course, very unlikely that anything like 3,000,000,000 barrels will be produced from this field, but it is certain that the field will produce large quantities of oil for many years to come.

Transportation facilities consist of pipe lines to Monterey, Point Richmond and Port Costa.

Map of California Oil Fields

isolated and the difficulties encountered in getting in supplies and fuel have hampered developments.

The Kern River field is about four miles across and nearly six miles long, and has produced almost 130,000,000 barrels of crude oil.

While the field produced for 1909, 14,508,000 barrels of oil, it is not likely that this amount will ever be reached again. Owing to continued low prices, many wells and a few whole leases had been closed down, waiting for better prices. Kern River is in no sense exhausted, but it is likely that there will be a gradual decline in production. Probably the field will never produce more oil in the future than it has in the past and it is likely that another ten years will have seen the production brought down to a nominal amount.

The depth of the wells vary from about 300 feet for the small producers of heavy oil near the break, to about 1500 feet for those back on the hill. The total number of producing wells is about 1410. The field is gradually extending further north.

Kern County.

Oil has been known to exist in Kern county since 1870, but no very extensive developments were attempted until after the first development of the Coalinga field, although some work had been done both at McKittrick and Sunset previous to that date.

Along the western edge of the county and on the north line of the county at Devil's Den, much work has been going on for several years past and oil has been found in paying quantities. The extent of these fields is not yet known, but it is very likely there will be developed large tracts of good oil land at some of these places. Devil's Den district is somewhat

The Midway field, known to exist for some years, never marketed any oil until within the last three years, except a small quantity from the extreme south and where this field joins Sunset, of which field it is really a continuation.

The proven wells of the Midway field proper cover a total length of 12 miles, and while the width is by no means proven, there is every reason to believe that the field is at least wider than McKittrick.

McKittrick was originally known as Asphalto, but the asphaltum industry did not prove profitable owing to excessive cost of production and transportation. Very little oil development was done at that time though several wells were sunk which yielded a few barrels daily. When the slump in oil came, the McKittrick field was practically closed down for over a year and for nearly four years very little new work was done. After the better times came, McKittrick got its revival, and today there are over 140 producing wells, with an average monthly production of over 450,000 barrels. The field is being rapidly extended to the north, south and east.

Transportation facilities consist of the Southern Pacific Railway and the Standard Pipe Line.

Sunset is the oldest field in Kern county and has until 1908, been almost wholly neglected. The principal cause of the delay in the development of this field has been the lack of transportation facilities and the heavy gravity of the oil.

The railway facilities have been increased, and the field is reached by the Standard pipe line. During the last 25 years many wells were put down and most of them produced oil of a heavy gravity. There were no railroads and the heavy oil could not be piped, so it was finally decided to build a refinery on the ground and turn the heavy oil into refined asphaltum, the product being hauled to Bakersfield by wagon.

On March 15th, 1910, the world's greatest gusher, the Lakeview, was struck with an output of 50,000 barrels per day, the oil being of a good quality and of 20 degrees Beaume. It seems reasonable from the work already done that the deeper the wells will be, the lighter the oil and the heavier the flow.

In the southern portion of the Sunset field are several wells producing a light oil of good quality, but the output is rather small.

Northern California.

The drilling for oil north of San Francisco, in Humboldt and Contra Costa counties and at Half Moon Bay does not seem to be successful in spite of the considerable work done.

South of Los Angeles.

The districts of Del Mar, Morena and Otay, San Diego county, have indications of petroleum and development operations are unusually active at the present time.

Texas.

It is a fact that the producers of eastern fields have long since reached their maximum and are becoming rapidly exhausted. The Texas field has much territory yet to drill that will result in large productions, but there the wells show an enormous gas pressure which generally results in short lived wells where the gas is allowed to escape.

Colorado, Wyoming and Utah.

It is quite possible that more fields will be opened in Colorado, although that state has reached its maximum production in the discovered fields. Wyoming will produce some oil. Utah already has a little oil, and there remain very good prospects.

Alaska.

Numerous seepages occur in Alaska, and several attempts have been made to drill wells, but so far without success. There is great difficulty in getting in material and in the actual drilling, owing to the fact that the entire surface of the country is covered with a deposit of sea mud some hundreds of feet thick, and it has been found to be almost impossible to force casing through this formation. It is not likely that the field, if there be a field, will be developed for many years to come.

Mexico.

There can be no question that Mexico soon will produce enormous quantities of crude oil. If this field is a continuation of the Texas field or Coastal Plain field, it seems reasonable to expect that the life of those fields may be taken as an example of the probable duration of this one. The Texas fields have to a large extent, been ruined by careless drilling, and the total production of that State has fallen off and is still falling off with great rapidity. This also is true of the Southern Louisiana field, so that these fields need not be reckoned with as likely to ever increase in production.

The oil fields of old Mexico are situated along the eastern shore from Tampico south nearly to Yucatan. A few seepages are along the western coast of Lower California, and one instance of crude oil seeping near the City of Mexico. Most of the new fields are located in the State of Vera Cruz and are conveniently reached by boat from Tampico, being about seventy miles up the river from the latter port.

In Mexico nearly all the proven or partly proven land is owned by a few large companies, and this fact alone will certainly not hasten development, so it is more than likely that before the product of the Mexico fields becomes a factor in the world's market, the output of other fields will be decreased in a corresponding amount.

The Mexican Petroleum Company has a pipe line to Tampico and another to the City of Mexico. The railroads of Mexico are rapidly adopting oil for fuel.

Very likely the British government will obtain most of their naval supply there in the future, as the Mexican fields will undoubtedly, when fully developed, produce an enormous quantity of oil, which will be shipped from Tampico and Vera Cruz.

It is probable that Mexico will not export any crude oil to California before the opening of the Panama Canal. All the producing wells are located in the eastern part of Mexico, and the few seepages occurring on the western coast have not yet been drilled for oil.

Chemical Composition of California Petroleum.

As regards its ultimate composition, crude petroleum consists essentially of carbon and hydrogen, together with oxygen, and usually widely varying amounts of nitrogen and sulphur. California crude

oils contain from 0.5 to 1.2 per cent nitrogen. The occurrence of sulphur in crude oil is due to the fact that free sulphur is always present in the earth's crust, though in highly variable amounts. Sulphur is freely soluble in oil, and occurs in the crude petroleum not only in a mere solution, but also very firmly combined to carbon and hydrogen as thio-ethers and mercaptans, commonly called organic sulphur.

California crude oil greatly varies in character, some oils being of a greenish or bluish fluorescence, while others are viscid and almost black. The specific gravity ranges from 0.993 to 0.850 or from 11 degrees Beaume to 34 degrees Beaume.

No. of Sample	Origin of the Oil		Gravity Spec.	Gravity Beaume	% Water by [illegible]	% Water by [illegible]	% Water by distill.	Flash Point Degs. Fahr.	B.T.U. [illegible] per pound	Gasoline %	Kerosene %	Fuel Oil %	Asphalt %	Loss %	% Sulphur
1	LOS ANGELES	[illegible]	0.9598	16	2.5	3.5	6.0	220	17735	0	2.0	52.0	34.6	4.1	2.31
2	DITTO	Harris Oil Co	0.9592	16	0	1.0	2.5	212	17990	0	0	64.0	33.2	3.3	2.35
3	DITTO	[illegible] Oil Co	0.9621	15.5	2.0	4.5	7.0	212	17815	0	2.0	54.1	34.0	2.9	1.99
4	DITTO	Union Oil Co	0.9432	18.5	0	0.	0.5	205	18109	0.2	3.0	68.4	25.0	2.9	1.60
5	DITTO	Mrs. Summers	0.9757	13.3	0	1.5	2.9	230	18210	0	2.4	58.6	35.5	3.2	1.01
6	DITTO	Amalgamated	0.9499	17.5	0	0.5	1.0	210	18105	0.2	3.5	67.5	25.3	2.5	1.97
7	WHITTIER	Murphy Oil Co	0.9432	18.6	1.75	3.7	4.8	Over 200	18295	0.8	9.0	59.75	23.5	2.85	0.74
8	DITTO	Union Oil Co	0.9402	19	0	0	0.8	90	18319	2	10.2	62.3	23.0	2.9	0.64
9	DITTO	Murphy [illegible]	0.9375	19.5	0	0.5	1.3	180	18332	0.8	10.1	62.8	22.9	2.1	0.47
10	DITTO	Ditto [illegible]	0.9425	18.5	1.0	2.1	3.5	Over 220	18381	0.9	10.5	59.8	23.0	2.3	0.91
11	DITTO	Central Oil Co	0.9260	21	0	0	0.6	85	18675	2.8	14.4	57.1	21.7	3.4	0.53
12	DITTO	Central Oil Co	0.9368	19.5	3	4.8	6.5	90	18410	0.8	11.0	57.7	22.9	1.1	0.63
13	NEWHALL		0.9585	16.1	0	0	0.3	175	17410	0.4	11.8	58.1	25.6	3.8	0.74
14	DITTO		0.9449	18.6	0	0	Trace	170	17775	0.7	12.6	58.7	25.1	2.9	0.62
15	FULLERTON		0.8565	33.1	0	0	Trace	Below 60	19405	24.9	25.0	35.1	13.6	1.4	0.97
16	DITTO		0.9252	21.5	0	0	0.8	160	19010	5.1	11.2	55.3	25.1	2.5	0.92
17	PUENTE		0.8961	26.6	0	0	Trace	Below 60	19270	14.3	21.9	35.9	25.8	2.1	0.79
18	BREA CANYON	Rice Well	0.9255	21.5	0.5	1.5	3.0	95	18871	4.1	9.8	58.3	21.0	3.8	0.77
19	DITTO	Graham & Loftus	0.9261	21.5	0	0	1.9	89	19010	3.5	11.2	59.2	21.8	2.9	0.64
20	DITTO	Industrial #1	0.9412	19	0	1.0	5.4	200	18475	0.7	12.0	55.1	22.9	3.0	0.72
21	DITTO	Industrial #2	0.9371	19.5	0	0	4.9	Over 200	18500	0.9	12.3	55.5	22.7	3.7	0.61
22	DITTO	Puente Oil Co	0.8785	29.5	0	0	0	75	19359	26.0	19.3	40.4	12.7	1.6	1.62
23	SALT LAKE	[illegible]	0.9722	14	1.0	2.5	4.3	245	17415	0	2.0	57.5	33.8	2.2	2.11
24	DITTO	Salt Lake Oil	0.9565	16.5	1.0	2.5	4.8	165	18771	0.8	8.0	54.4	29.5	2.8	2.02
25	DITTO	West Coast	0.9402	19	0	0	2.3	94	18910	0.9	12.2	54.1	22.6	3.1	1.97
26	SUMMERLAND	[illegible] & Son	0.9683	14.6	2.5	3.5	4.5	270	18571	0	3.0	58.7	32.0	1.8	1.02
27	DITTO	[illegible] & Son	0.9702	14.3	2.2	2.5	3.9	318	18601	0	3.0	57.7	32.5	2.9	0.99
28	DITTO	Bennett #1	0.9734	12.6	2.5	3.5	4.3	344	18489	0	2.5	56.4	34.0	2.8	0.92
29	DITTO	Bennett #2	0.9773	13	2.5	3.5	4.7	310	18511	0	3.0	55.4	34.0	2.9	0.95
30	DITTO	[illegible]	0.9775	13	1.2	2.0	2.8	308	18472	0	3.0	56.5	33.5	4.2	0.89
31	DITTO	Seaside #1	0.9787	13.1	2.3	3.5	4.3	308	18499	0	3.0	56.6	34.0	1.9	0.91
32	DITTO	Seaside #2	0.9775	13	1.5	2.0	3.6	310	18505	0	3.0	56.3	34.0	3.1	0.91
33	DITTO	[illegible] Becker	0.9665	15.0	2.0	2.4	4.5	210	18437	0	3.0	58.1	31.3	3.1	0.75
34	SANTA MARIA	Union Oil Co	0.9034	24.6	0	0	1.0	75	19114	5.0	12.5	61.2	17.0	3.3	1.55
35	DITTO	Western Union	0.9047	25	0	0	0.5	80	19070	7.0	11.9	61.5	18.2	0.9	1.61
36	DITTO	Dome Oil	0.9061	24.8	0	0	1.2	75	18974	5.0	12.8	60.6	17.5	2.9	1.75
37	DITTO	Palmer Oil	0.9756	13.5	0	1.5	2.9	270	18365	0	2.8	58.6	32.5	3.2	1.58
38	SANTA PAULA	Lapp—[illegible]	0.8931	27	0	0	Trace	75	19215	15.1	17.3	53.8	11.5	2.1	0.67
39	DITTO	Cosmopolitan	0.8656	32	0	1.0	2.9	Below 50	19419	18.9	13.5	52.8	10.0	1.9	0.70
40	KERN RIVER	Santa Fe	0.9840	12.4	2.5	1.5	3.2	295	17825	0	0	56.9	36.8	3.1	1.02
41	DITTO	Ditto	0.9631	14.6	0	0	0.4	285	17910	0	2.0	60.8	34.9	1.9	1.10
42	DITTO	Ditto	0.9659	15	0	0	0.5	280	18210	0	2.0	61.3	32.1	4.1	1.08
43	DITTO	[illegible] Crude	0.9725	14	1.0	1.9	3.5	290	18115	0	0	58.2	35.1	3.2	0.98
44	DITTO	Reid Crude	0.9765	13.0	1.5	2.5	6.3	310	17910	0	0	56.6	36.3	0.8	1.11
45	DITTO	[illegible] Oil	0.9657	15	0	0	0.8	275	18010	0	2.0	62.1	34.4	0.7	1.02
46	DITTO	Stauffer	0.9688	14.5	0	0	0.6	290	18224	0	1.5	60.4	35.6	1.9	0.96
47	DITTO	Union	0.9529	17	0	0	0.4	275	18115	0	2.0	58.7	36.1	2.8	0.93
48	McKITTRICK	State Oil	0.9595	16	0	0	1.1	330	18369	0	3.0	59.4	33.2	3.3	1.30
49	DITTO	State Oil	0.9835	12.3	2.5	4.8	7.6	310	17775	0	0	50.0	39.1	3.3	0.91
50	DITTO	Delmonte	0.9560	16.5	3.0	4.5	4.9	180	18205	1.0	3.0	50.9	34.0	4.2	0.98
51	DITTO	[illegible]	0.9530	17	0	0	Trace	210	18415	0.5	3.0	62.5	31.0	2.1	0.97
52	DITTO	Santa Fe	0.9593	16	0	0	0.2	225	18339	0	2.5	63.3	33.1	0.9	1.01
53	SUNSET	Wellman	0.9433	18.5	0	0	0.5	Over 200	18885	1.0	9.0	57.4	30.0	2.1	1.02
54	DITTO	Union	0.9410	18.4	0	0	0.8	180	19019	1.0	9.5	56.4	29.7	2.2	1.30
55	DITTO	Union	0.9931	11	2.5	5.0	8.1	330	17453	0	0	46.6	41.0	4.1	1.32
56	DITTO	K. T. and O.	0.9790	13	0.5	1.0	2.2	300	17890	0	0	54.9	39.0	3.9	1.09
57	DITTO	Ditto	0.9504	17.6	0	0	1.0	190	18199	2.2	11.3	57.5	31.9	2.1	0.98
58	DITTO	Ditto	0.9425	18.5	0	0	0.8	165	18310	2.5	13.0	57.3	24.3	2.1	1.31
59	DITTO	Ethel D.	0.9832	12.5	1.0	2.0	4.1	320	17911	0	0	54.6	38.2	3.1	1.28
60	MIDWAY	Associated	0.9011	25.6	0	0	Trace	65	19125	21.0	20.0	41.6	13.1	4.3	1.18
61	DITTO	Standard	0.9130	23.5	0	0	0	48	10091	14.0	20.0	45.0	15.1	0.9	1.19
62	DITTO	Ditto	0.9727	14	0	0.5	1.5	275	18010	0	2.0	66.8	28.7	1.0	0.96
63	DITTO	Ditto	0.9432	18.3	0	1.1	3.2	205	18990	2.8	12.8	46.8	32.1	2.3	0.82
64	DITTO	Santa Fe	0.9434	14.5	0.5	1.5	3.5	Over 200	19005	3.0	13.0	43.3	33.2	4.0	1.09
65	DITTO	Eagle Creek	0.9631	15.5	5.0	2.0	3.6	280	18111	0	2.0	60.4	30.9	3.1	1.10
66	COALINGA	Amer. Petrol.	0.9502	17.5	0	1.2	2.8	308	18411	0	2.0	61.4	31.5	2.3	0.81
67	DITTO	Ditto	0.9412	19	0	0	0.6	310	18684	1.5	12.0	55.0	29.0	1.9	0.75
68	DITTO	Ditto	0.9860	12	1.0	2.5	4.0	280	18125	0	0	56.6	35.1	4.1	0.77
69	DITTO	Union	0.9561	16.5	0	0	1.0	170	18430	0	2.0	62.0	21.1	3.9	1.68
70	DITTO	Associated	0.9433	18.5	0	0	0.7	Over 200	18680	0	2.0	71.1	23.0	3.2	0.73
71	DITTO	Standard	0.9185	24	0	0	Trace	75	19020	2.0	16.0	66.2	13.0	2.8	0.69
72	DITTO	Premier	0.9222	22	0	0	0.2	90	18975	1.5	14.0	66.7	14.5	3.1	0.74
73	DITTO	Associated	0.9460	17.3	2.0	2.5	4.7	310	17615	0	0	52.3	39.7	3.3	0.64
74	DITTO	K. T. and O.	0.9631	15.5	1.0	1.8	3.0	275	18117	0	2.0	61.1	33.1	0.8	0.69
75	DITTO	Ditto	0.9403	19	0	0	0.3	160	18810	4.0	12.4	57.7	24.3	1.3	0.70
76	DITTO	Ditto	0.9454	18.1	1.0	2.0	3.2	170	18705	2.5	11.0	62.3	21.7	3.3	0.75
77	DITTO	Associated	0.9915	10.2	2.5	3.5	5.0	325	17985	0	0	52.5	41.0	0.9	0.71
78	DITTO	[illegible] Consol.	0.9786	13.2	1.5	3.9	7.5	315	18027	0	0	35.2	54.0	1.3	0.70

Analysis of California Oils

The oils of California contain sometimes as much as 45 per cent asphaltum and for that reason the gasoline test for determination of foreign matter in the oil is not always practicable on account of the asphaltene forming a sludge with the gasoline. The centrifugal test is more correct, but the only way to determine accurately the percentage of water and foreign matter in crude petroleum is the distillation test.

The amount of sulphur in California crude oil varies between 0.5 per cent and 2.5 per cent. The only thoroughly satisfactory process for determination of sulphur is that of combustion in oxygen in the Mahler bomb and determination in the usual way as barium sulphate.

The accompanying table shows analysis of 78 different samples if California crude oil, taken from oil districts shown on the map.

For the large amount of work in gathering these samples credit is due Mr. Henry C. Kayser and every analysis was made by him in the laboratory of the Southern California Edison Company at Los Angeles.

In collecting the samples to be tested greatest care was taken, some of them were taken directly at the well, some of them from storage tanks, while others were taken from tank cars as received at the gas plants. The samples were taken with a so-called "oil-thief" and placed in a large receptacle and the whole thoroughly mixed. In all classes the specific gravity was ascertained by picnometer at 60 degrees Fahrenheit, after the water was allowed to settle.

Summary of the Oil Situation in California.

Los Angeles City field with its extension toward Santa Monica (Salt Lake, Sherman, Beverly, Malibu), will be a large factor in the oil market for many years to come, although most of the wells show a high percentage in sulphur.

The oil from the Whittier field is sought after by the refiners and the gas plants in Los Angeles and its vicinity. The output is still increasing.

The Santa Fe Railway practically controls the entire production of the Fullerton field. The output is being increased yearly.

The wells of the Puente fields reached their maximum; the output per month is small and does not exceed 3000 barrels.

The oil from the Newhall field is out of question for the gas works; most of the product goes to the Standard's refineries.

Santa Paula oil is first class oil for gas making; contains less than one per cent sulphur; oil is of light gravity. Transportation facilities are excellent. Production seems to have reached its maximum.

The oil from the Santa Maria field contains between 1.50 and 1:75 per cent sulphur. In some oil water trouble is met with. Production is increasing. Union Oil Company handles about four-fifths of the entire production.

The production in the Summerland field is rapidly decreasing. All of the oils contain over one per cent sulphur.

On an average the oil from Coalinga field yields less than one per cent sulphur. Transportation facilities consist of pipe lines to Monterey, Point Richmond and Port Costa. The production is increasing.

The production in Kern county, comprising Kern River, McKittrick, Midway and Sunset (Maricopa), is rapidly increasing through several gushers struck in March, 1910. The oil is of good quality and the transportation facilities will be developed more and more.

Experts who have studied the fields have reported that the oil beds in California will be prolific producers for more than half a century. A geologist who is considered an authority on oil, has stated that the present proven oil territories of California were sufficient to produce at least 75,000,000 barrels, every year for the next fifty years.

The price of oil was always subject to severe fluctuations. From experience we know that, when we had only a few wells in California, oil was selling as high as 75 cents a barrell; with the increase in number of wells and no readiness for the consumption, the oil dropped as low as 10 cents a barrel. Later on, while the consumption was increasing, oil went up again.

The question of supply and demand, production and consumption, is a very important one. We know that when the consumption increases and the demand becomes greater, the price of oil goes up; on the contrary, when production is greater than consumption, the price must naturally sink, unless there is enough storage capacity.

Since March, 1910, through the big gushers in Maricopa, the production was on the increase.

In March the average daily production for the Coast, San Joaquin Valley, and Southern Fields combined amounted to .... 194,278 bbls.
The average daily consumption reached 183,209 "

Average daily surplus .... 11,069 "

The stocks Feb. 28, 1910, amounted......19,225,950 "
The stocks March 31, 1910, amounted...19,569,085 "
The stocks April 30, 1910, amounted ......20,704,352 "
The stocks May 31, 1910, amounted.........22,940,599 "

Recent data in reference to surplus stock has not been obtainable. The oil producers show a tendency to withhold the information.

Unquestionably there is overproduction, and just now this condition is making buyers hold off, expecting a break in the price. The great marketing concerns will probably be unable to handle for a time the output of some of the big wells. On the other hand, transportation facilities are also increasing but they do not seem to keep up the race with the production, proof: The steady monthly increase of storage.

TELEPHONE SERVICE ON THE ISTHMUS.

The plan of laying an underground cable to provide permanent telephone facilities along the Panama railroad relocation has been abandoned. A requisition was placed some time ago for the necessary material, but only one proposal was received in response to the advertisement for bids for the cable, and the price, 48 cents a foot, was considered excessive. It has been arranged to construct a telephone line of iron poles, with their bases set in concrete, starting at Caimito and proceeding north to Monte Lirio. At Monte Lirio the relocation work is still in progress, but it is expected that it will be completed by the time the telephone construction force reaches there. The new pole route will carry 20 No. 10 copper circuits. At the south end of the relocation, comprising the section between Paraiso and Corozal, the pole line will parallel the railroad right-of-way for most of the distance, but will diverge at the approach to Miraflores tunnel, in order to go around the high part of the hill. There is no immediate demand for the construction of this part of the line, and it will not be started until after the Gamboa-Gatun section is completed.

CHEMICAL CONTROL OF OIL GAS MANUFACTURE.[1]

BY E. L. HALL.

By chemical control is meant the technical supervision over the process of manufacture necessary for maintaining or improving the quality of the product, while at the same time endeavoring to reduce the cost per unit. Chemical control will be treated of in this paper from the standpoint of conditions on the Pacific Slope where the bulk of illuminating gas is made from crude oil alone.

The problems confronting the oil gas chemist are mainly the same as in water gas or coal gas. They are, however, if anything, simpler, due to the elimination of coal as a manufacturing material and of coke and tar as by-products, but there are some problems peculiar to oil gas.

The routine duties of the oil gas chemist may be divided under the following heads:

1. Control for illuminating and calorific values.
2. Control for purification.
3. Control for napthalene troubles.
4. Miscellaneous control.
5. Control of operating conditions and technical report.
6. Valuation of raw materials.
8. Appliance work and illuminating photometry.

Control for Illuminating and Calorific Values.

A sufficiency of tests should be made to enable the foreman or head gas maker to keep the product uniform. The larger the holder capacity, the easier it will be to maintain a uniform standard.

All tests for record should be made at the outlet of the main storage holder. I would strongly deprecate the practice of estimating the quality of the product by test at the inlet of the storage holder for the following reasons:

The proper place for the final valuation of the quality is as near as possible to the actual consumer, that is to say, the outlet of the storage holder. At this point the loss in candle-power becomes more gradual, for it is not generally recognized that there is quite an appreciable drop in quality while the gas travels from inlet to outlet of the holder. The effect of the consumer's service is well represented by the small laboratory service.

The control of the actual operation of the generators can still be carried out by means of the test line at the inlet of the holder with the difference now that the tests are no longer for record.

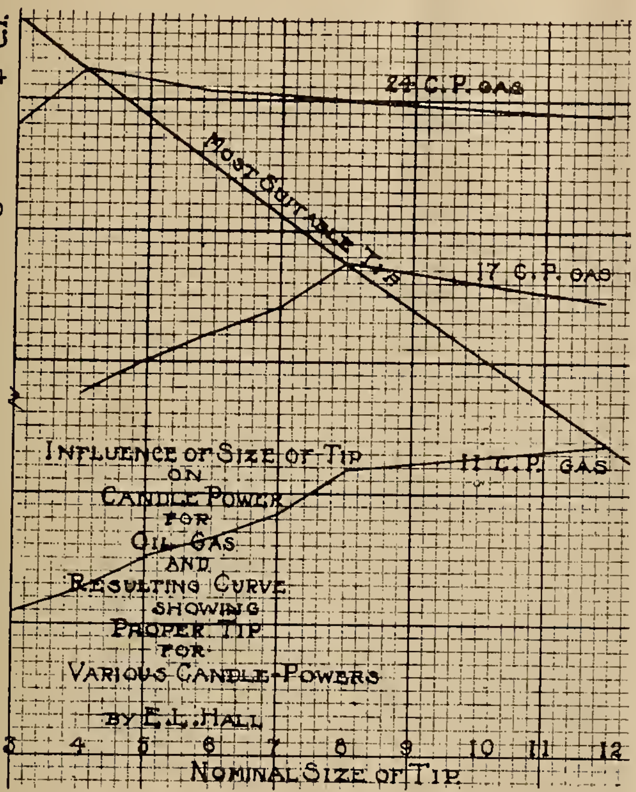
By this means of control, the candlepower of the gas in the street mains should be kept within a daily maximum variation of one candle, and within a monthly average maximum and average minimum difference of one-quarter candlepower.

A thorough knowledge of the working of the generator and the result to the candle-power in the holder from any particular variation from the routine and the ability to offset this by some other change, is the true secret of quality control, which is, of course, rendered much easier when a number of sets are operating together. It is greatly desirable that the night

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, September, 1910.

foreman or engineer be able to continue this system of control.

In making tests for illuminating power on the bar photometer, it is very seldom that enough attention is given to selection of the proper tip to develop to the full the candle-power inherent to the gas under test. In this connection, it may be of interest to show the accompanying diagram worked out for oil gas, illustrating the wide variations of candle-power with tips of different sizes. In this experiment full time was given at each test for the gases of different quality to purge out the photometer meter and connections.



Two things are apparent from the diagram:

1. The tip orifice should be smaller with an appreciation in the quality of the gas, and vice versa. This will result in a change of the issuing velocity of the gas, drawing in more primary air into the flame, thus burning in the inner cone a greater amount of the carbon of decomposition. In finding the proper tip, one merely determines what part of the carbon in the gas it is necessary to burn in the inner cone to raise the remainder to the highest degree of luminosity. This happens generally when the flame is just on the point of smoking.

2. That where there is any considerable change in the quality of the gas to be tested, it is imperative to find the proper tip for the test by a preliminary trial, and this is the more important as the quality diminishes.

It becomes natural to wonder where the consumer "comes off at" in this case. The answer is, that having determined the most satisfactory candle-power to carry, and having educated the consumer up to the proper tip for this candle-power, the quality of the gas made should not vary enough to render a change of tip necessary. Happily, moreover, the illuminating standard is gradually yielding to the calorific standard, which is really of more concern to the consumer. The practice of estimating illuminating values with the open tip has been shown to be open to considerable error, and even the proper open tip for the quality under consideration does not develop the full value of the flame.

The use of Argand burners, and especially of the No. 2 Metropolitan (Carpenter) burner thus becomes imperative. The latter, as shown by the diagram, will develop from two to three more candle-power than the most suitable tip and is adjustable for the variation in quality. The relative effectiveness of this burner diminishes with the higher illuminating values, when tests are made at five cubic feet per hour, and with the same length of chimney.

I will not go more fully into bar photometer work except for the following hints:

There is no excuse at present for making bar photometer tests with any other than the pentane standard.

The light on the bar photometer should burn continuously. It is better that the gas for testing should not pass through a service meter.

If the gas shows a tendency to deposit light oils in the test meter, the latter should be frequently drained out and refilled. The service and photometer connections should be well graded towards drips which should be regularly drained.

In connection with the illuminating value of oil gas, it must be borne in mind that high value by no means signifies good service to the consumer. It has been my experience that anything above 19 or 20 candle-power is going to give a great deal of dissatisfaction, mainly by reason of imperfect combustion, and because of the larger size of the flame which causes increased breakage in globes, chimneys and shades.

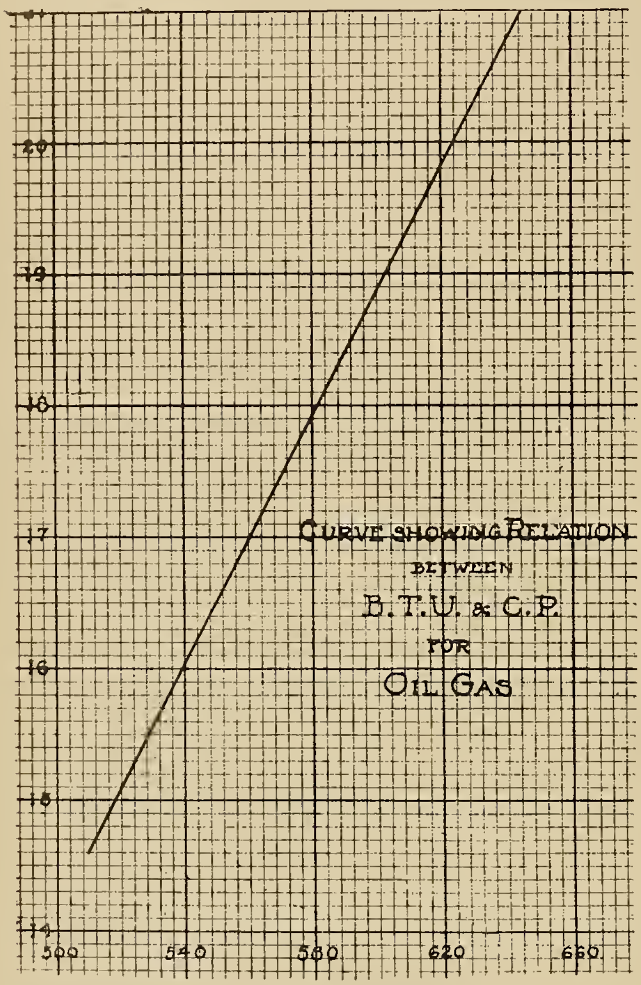
While the time has not yet arrived when we can altogether abandon the illuminating standard of quality, yet the calorific requirements can now be said to be of the first importance. It is doubtless true, that with most manufactured illuminating gases, high calorific value follows from high illuminating value. The relation between illuminating and calorific values seems to be fully constant for oil gas where the manufacture is not complicated by the utilization of lamp black as a generator fuel. The accompanying diagram will serve to represent the relation between the two. It cannot be said definitely that the same is unvariable or that the curve should be a straight line. The diagram has been plotted from the averages of many simultaneous illuminating and calorific tests.

Calorific tests should invariably be made as closely as possible after the illuminating test, and preferably upon the same stored sample which can also be used for the gas analysis. In this way, we are enabled to obtain definite relations between the three tests, and we have in addition, checks upon the daily valuation of the product.

A point often overlooked in calorimetry is the maintaining of the water supply, room temperature and the waste gases from the instrument at as near the same temperature as possible. For this purpose a water tank holding sufficient supply for twenty-four hours is very advisable. In making the calorimeter tests the water heated by the gas under test should be weighed,

not measured. The very sensitive thermometers used in making the observations of temperature should by all means have been compared and found in agreement with a calibrated thermometer.

It is well for the gas chemist to avail himself of the splendid service afforded by the Bureau of Standards at Washington, D. C., for the calibration of all the laboratory instruments where especial accuracy is required, among which may be mentioned the calorimeter thermometers and the pentane lamp.



Control for Purifications.

Probably no department of the works is more vital than the purifiers. It can be said also that the vigilance of the chemist should nowhere else be more strictly exercised. Owing to the varying percentages of sulphur in crude oil from different fields, the purifiers may be called upon most unexpectedly to handle greatly increased amounts of hydrogen sulphide.

The purification control should include the following routine work:

A. Daily estimation of the amount of hydrogen sulphide.

There is no better rapid test for this purpose than the titration of the raw gas with a standard solution of iodine of which 1 c.c. corresponds to 100 grains of sulphur per 100 cu. ft. The Tutwiller burette is very convenient for this purpose. The use of starch solution as the confining fluid may be used in place of mercury, providing that the titration be done at once upon collecting the sample. It will be necessary to make a blank test to ascertain the amount of the iodine solution to color the starch solution to the shade of blue which is to be used for the end point of the titration, which is to be deducted from the amount used to take up the hydrogen sulphide.

Where a number of purifiers are operating in series, the work performed by each box may be ascertained by making a series of tests in which every box successively occupies the same relative position.

It is possible by this method of testing, to determine exactly what percentage of the total sulphur is being removed by each box. It may be found that a box showing foul in the first position may still be removing a large percentage of the total sulphur.

B. The condition of the material in the purifiers should also be ascertained by monthly analysis for sulphur, tar and cyanogen products. The following method has been found to be satisfactory for estimating on the same sample, moisture, total cyanogen and sulphur.

Ten grams of the oxide which has been removed from the purifier at the close of the revivification and bottled, are weighed out into a watch glass and dried to constant weight in an air bath at 100 degrees C. The loss in weight gives moisture. The same sample is now introduced into a Soxhlet extraction apparatus and extracted for one hour with redistilled bisulphide of carbon. The extract evaporated to dryness represents the sulphur contained in the sample and should be melted before weighing. The residue of oxide can be used for estimating the cyanogen contents. The same is slightly warmed with a dilute solution of caustic soda, the solution cooled and made up to 500 c.c. of which an aliquot part is used. Make slightly acid, warm gently, and precipitate with a dilute solution of ferric chloride. The percipitate of Prussian blue must be washed several times by decantation and finally on the filter until free from chlorides, dried, ignited and weighed as ferric oxide, which can be calculated back to Prussian blue, in which form the cyanogen is to be reported.

Purifying materials used for oil gas may, with good management, be run up to as high a percentage of sulphur as in coal gas or water gas manufacture. The Prussian blue contents have a very important bearing upon the life of the oxide because the iron present in the Prussian blue is permanently incapable of sulphur removal and also acts as a coating over the remainder of the oxide of iron. Samples of oxide used for oil gas have come under my observation containing as high as ten per cent by weight of Prussian blue.

The estimation of tar in oxide should not be necessary in a well-equipped plant. The approximate estimation of the same can be carried out by treating the sample with solvents to dissolve out the tarry matters which may then be evaporated to dryness.

To insure the freedom of the purified gas from traces of hydrogen sulphide, no more delicate test can be devised than the well known sugar of lead test. It is possible, by using a revolving disc carrying a chart similar to a Bristol recording gauge, impregnated with lead acetate, and dried, which is exposed to a tiny jet of the gas to be tested, to obtain a continuous record of freedom from hydrogen sulphide.

C. As is well known, the sulphur contents of oil gas are not limited to hydrogen sulphide. A large portion of the sulphur appears in an organic form, which

by reason of the difficulty attending its removal, would seem to have deserved more attention than has been given it.

The presence of this impurity is not indicated by the sugar of lead test and can only be estimated by a combustion of the gas. The analysis is conveniently carried out as follows: A small jet of gas, burning at the rate of 0.2 cu. ft. per hour, which has been accurately measured by passing through a test meter, is kept burning in a glass flask of about one liter capacity, containing two openings. The side opening communicates with several wash bottles filled with broken glass or marbles and containing dilute caustic soda. The other opening of the flask is at the bottom and communicates with another series of three absorption bottles containing a solution of sodium carbonate to which has been added a few drops of bromine. The outlet of these bottles is connected to a source of suction. By means of a two hole stopper, the gas jet is inserted into the side opening flask. A rapid flow of air, purified by bubbling through the caustic soda bottle, is drawn through the flask and the sodium carbonate absorption bottles. The products of combustion of the gas, which contain the organic sulphur as sulphurous acid, pass with the air into the sodium carbonate bottles, where the sulphurous acid is oxidized by the bromine to sulphuric and retained by the sodium carbonate. After one to five cubic feet of gas have been burned, the sodium carbonate solution is transferred to a beaker, and the bottles and flask well rinsed with distilled water. The solution, made slightly acid with hydrochloric acid, is precipitated with barium chloride in the usual way for estimation of sulphur, which is reported in grains per 100 cu. ft.

D. While not strictly to be classified as routine work, the differentiation of the organic sulphur compounds in oil gas bears such a close relation to the study of the subject that the work should be carried on more than intermittently. Good methods are not yet available to enable the gas chemist to report with certainty as to the nature of the various sulphur compounds present.

The absorption of bisulphide of carbon may be effected with alcoholic potash. The alkaline solution is evaporated, dissolved in distilled water and made slightly acid with acetic acid. A very dilute solution of copper sulphate is added, drop by drop, until a permanent yellow precipitate of cuprous xanthate is produced which is allowed to stand and filtered off. The precipitate is washed on the filter, dried, ignited and weighed as cupric oxide, from which the sulphur is calculated and reported as bisulphide of carbon in grains per 100 cu. ft.

It is not certain that other sulphur compounds may not also react with the alcoholic potash.

It is desirable that a good method be worked out for the separation and estimation of mercaptans, the presence of which may be shown qualitatively by means of mercury compounds.

Thiophene and sulphocyanides have been found in oil gas but not quantitatively estimated. The subject is worthy of a good deal of investigation and good working methods for the separation and estimation of these bodies as occurring in illuminating gas would prove very acceptable.

Control for Naphthalene Troubles.

Owing to the high heats employed for making oil gas, naphthalene troubles are as much present as in either coal gas or water gas. Owing to the large amount of scrubbing water necessarily employed for the washing out of lamp black, the gas does not enjoy that full contact wth tar and tar oils which might serve to reduce the quantity of naphthalene.

Happily, on the Pacific Coast, the problem is no longer perplexing. There are several plants at present equipped with scrubbers for washing the gas with crude oil. Where this method is employed, naphthalene troubles are practically unknown. Where the chemist is called upon to determine the amount of naphthalene present in the gas, he is likely to be confronted with analyses showing quite variable amounts of naphthalene. It is my opinion that the analysis itself is not at fault, and that the fluctuations observed are actually present. The method employed is as follows:

The sampling is done by inserting into the main, to a point about one-third of the diameter, a glass tube bent to a right angle at one end, which is pointed in the direction of the flow of gas. The other end communicates with a Pettenkoffer tube for absorption with standard picric acid solution. The tube consists of a piece of glass combustion tubing about three feet long, sealed at one end. The other end is slightly widened to receive a two-holed rubber stopper. The tube leading the gas from the main is carried without joints through the stopper to the other end of the Pettenkoffer tube and is drawn down to a fine opening. The outlet of the apparatus communicates with a test meter for measuring the volume of gas used and is placed at a slight angle from the horizontal. A measured amount of the picric acid solution is run out from a burette into the apparatus, the same is connected up to the main and about 5 cu. ft. are bubbled through slowly. The picric acid is then transferred to a rubber stoppered bottle which can be exhausted of a part of its air. The bottle and contents are heated in warm water until the naphthalene precipitate is dissolved. The solution is allowed to cool over night and the precipitate filtered off and washed with as little cold water as possible. The picric acid is now titrated against a standard caustic soda solution. The loss in picric acid is calculated back to the naphthalene equivalent and the same reported in grains per 100 cu. ft.

The picric acid solution may be used qualitatively to indicate the presence of large or small amounts of naphthalene by bubbling some of the gas rapidly through a test tube containing a few c.c. of this solution. Should no precipitate appear after two minutes bubbling, the gas may be taken as being reasonably free from naphthalene.

(To be continued.)

Examination for aid, Coast and Geodetic Survey, is announced by the United States Civil Service Commission on November 22-23, 1910, to fill about ten vacancies in the position of deck officer and similar vacancies as they may occur in the positions of aid and deck officer in the Coast and Geodetic Survey.

HORATIO A. FOSTER ADDRESSES LOS ANGELES SECTION A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers opened the year's proceedings with a dinner at the Hotel Hollenbeck, Tuesday evening, October 25th. Mr. C. G. Pyle was in charge of the preparations and the affair was unusually successful. There were eighty-nine members in attendance, great interest being taken in the paper of the evening, which was entitled "Necessity for Valuations" by Horatio A. Foster.

Mr. Foster took a broad view of this subject, quoting from Mr. Roosevelt's Decoration Day speech at Indianapolis in 1907, as follows: "At the outset let it be understood that physical valuation is no panacea; it is no sufficient measurement of a rate; but it will be ultimately needed as an essential instrument in administrative supervision. Therefore the physical valuation can never be more than one of many elements to be considered; but it is one element, and at times may be a very important element, when taken in connection with the earning power and business possibilities in reaching an estimate on the property and rights of a corporation as a going concern."

"The effect of such valuation and supervision of securities cannot be retroactive. Existing securities should be tested by the laws in existence at the time of their issue. This nation would no more injure securities which have become an important part of the national wealth than it would consider a proposition to repudiate the public debt. But the public interest requires guaranty against improper multiplication of securities in the future." Mr. Foster continued: "A true valuation must not only show the market value today of the physical or tangible property, but different percentages must be added for overhead charges, such as contractors' profit, engineering and superintendence, organization and legal expenses, interest during construction, insurance during construction, contingencies, discount on bonds, and in many cases, a percentage must be added for working capital. All of these (in some cases amounting to at least 25 per cent), must be added to the actual physical values in order to make a correct appraisal of the tangible property of the company.

A complete appraisal, exclusive of the above overhead charges, should show the separate total values for the following:

(A) Cost to reproduce new.
(B) Present value, which means the depreciated value.
(C) Physical development charges.

The above values may be used for:

(A) Rate making.
(B) Sale and transfer of property.
(C) Bond issue.
(D) Total capitalization.
(E) Establishing a uniform system of accounting.

In addition to these it may at times be necessary to make an additional study of values when considering improvements and extensions needed to provide adequate service.

After analyzing these various items in detail, Mr. Foster took up the much discussed problem of the Going Value or Good Will of a corporation, quoting a number of Supreme Court decisions and also the decisions of the various Public Service Commissions in the United States. In part, Mr. Foster said: "The Maine court ruled that the 'going concern' or 'established business' is an element of structure value. It may be defined as the cost of establishing, up to the level of the net income of the old plant at the date of taking, the business of a similar new plant (but not of a mere perfect system which the city might build), which is supposed to begin operation upon the date of the taking, the old plant going out of business at the same moment. Or, to put the same thing in another way, it is the measure of the greater value (at the date of taking) of an old established plant, over a similar new plant completed and ready for operation upon the date of taking. Or, to put the same thing in still another way, it is the measure of the cost of developing the business of a new plant to a point coincident with the net income, upon the date of taking, of the old plant."

He then took up Franchise Values, stating as follows: "This is one of the most troublesome questions that comes before the appraiser and the values have been determined in a number of different ways. Perhaps that made use of by the Ford Franchise Commission in New York State has been carried the farthest. In this case an appraisal is made of the physical property of the company and to this is added the capitalization of the net earnings of the company, such capitalization being made at 2, 3, 4 or 5 per cent, according to the class of the city; this total is then called the assessed value of the franchise which is taxed, and it is this method which has been fought so long and hard by all public utilities corporations in New York State, and which has, in every case, been sustained by the courts, clear up to and including the Supreme Court of the United States, and the companies have had to compromise or pay according to this assessment. This, perhaps, is the best evidence existing to show a method of valuing a franchise."

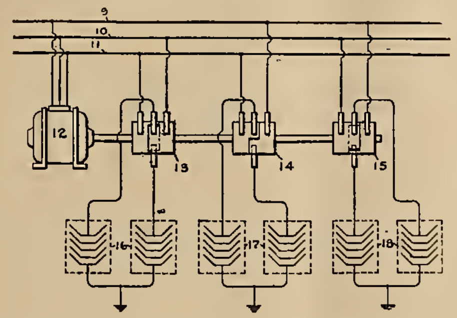
In concluding his paper Mr. Foster gave a masterful analysis of the subject of Depreciation. He quoted a decision of the Supreme Court of the United States rendered in the Knoxville water case, as follows: "A water plant, with all its additions, begins to depreciate in value from the moment of its use. Before coming to the question of profit at all the company is entitled to earn a sufficieut sum annually to provide not only for current repairs, but for making good the depreciation and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually waste without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired so that at the end of any given term of years the original investment remains as it was at the beginning. It is not only the right of the company to make such a provision, but it is its duty to its bond and stockholders, and, in the case of a public-service corporation at least, its plain duty to the public. If a different course were pursued the only method of providing for replacement of property which has ceased to be useful would be the investment of new capital and the issue of new bonds or stocks. This course would lead to a constantly increasing variance between present value and bond and stock capitalization—a tendency which would inevitably lead to disaster either to the stockholders or to the public, or both. If, however, a company fails to perform this duty and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon over issues of securities, or of omission to exact prices for the output, the fault is its own. When, therefore, a public regulation of its prices comes under question the true value of the property then employed for the purpose of earning a return cannot be enhanced by a consideration of the errors of management which have been committed in the past."

The Los Angeles Section will hold seven technical meetings during the coming year and an exceedingly interesting program of papers has been promised for presentation at these meetings.

The new executive committee is made up of the following members: J. E. Macdonald (chairman), V. L. Benedict (secretary), E. R. Northmore (assistant secretary), I. T. Dyer, J. A. Lighthipe, E. R. Davis and R. H. Manahan.

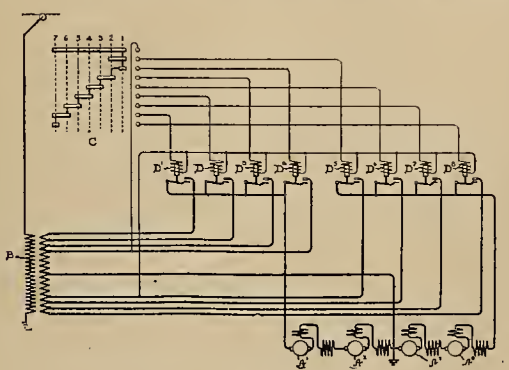
PATENTS

973,555. **Lightning Arrester.** Frank W. Peek, Jr., Schenectady, N. Y., assignor to General Electric Company. A protective device for alternating current systems comprising a



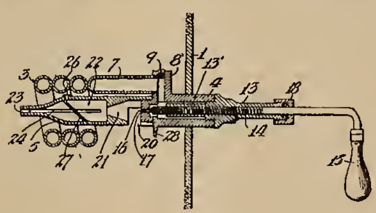
current limiting condenser forming a discharge path for abnormal potentials, and means for deriving a unidirectional potential from the system to be protected and for impressing said potential upon said condenser.

973,575. **Motor Control.** Walter I. Slichter, Schenectady, N. Y., assignor to General Electric Company. The method of operating a plurality of electric motors mechanically connected to drive a common load, and connected electrically in



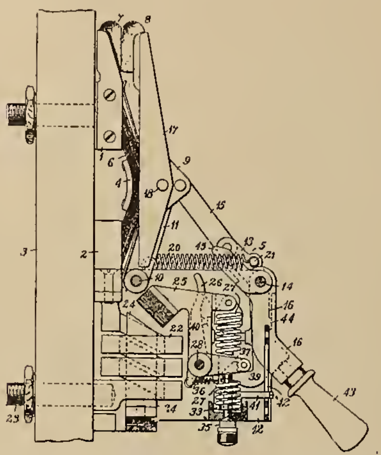
a plurality of groups, which consists in starting the motors by impressing reduced voltages on the groups, and increasing the voltages on said groups alternately step-by-step, the voltage being maintained on one group while the voltage on another group is being increased.

973,804. **Gas Generating Oil Burner.** Thomas Muehleisen, San Diego, Cal. An oil burner comprising an oil supply connection provided with a valve, a retort having an inlet connected to said valve, a regulating valve connected to the outlet of said retort, a combined burner head and mixing chamber connected to said regulating valve and extending therefrom



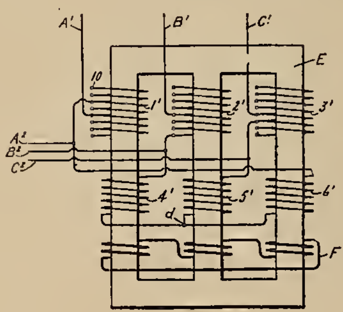
within the retort, said burner head and mixing chamber having a main outlet for producing a main burner flame and auxiliary outlets for directing auxiliary heat onto the retort, and a deflector in said mixing chamber to force the gas through said auxiliary outlets, said retort being out of the path of the main burner flame, so that the retort is subjected only to sufficient heat to vaporize the oil without carbonizing it.

973,924. **Circuit Breaker.** James C. Dow, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. In a circuit breaker, the combination with an insulating base plate, stationary and movable contact members, an interposed link, a bell crank operating lever having an inwardly extending hooked projection, and a bell crank latch pivotally supported between the operating lever and the base and



adapted to co-operate with the hooked projection of the operating lever in holding the breaker closed, of a release magnet having a movable core member pivotally mounted coaxially with the latch and resiliently connected thereto, and a handle lever supported coaxially with the operating lever and having a projection adapted either to close the breaker or to engage the latch in releasing the breaker.

973,579. **Voltage Regulator.** Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. The combination with a three-phase system, of a three-phase Y-wound transformer connected thereto, regulating windings



in inductive relation with each of the transformer windings each connected in series with one of the transformer windings, the regulating and transformer windings being so connected that each transformer winding induces in each regulating winding a voltage substantially in quadrature with the voltage of a phase of the system adjacent to the regulating winding and so does not affect the latter voltage, and means for maintaining the neutral point of the transformer windings stable.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

DIRECTORS

R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong

604 Mission Street, San Francisco

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Speed Control of Induction Notors

Great ingenuity has been exercised in imparting to the alternating current induction motor a quality for which there is increasing demand, but one which is not inherent in this useful piece of apparatus—that of variable speed. Though the polyphase induction motor is of simple design and rugged construction and well adapted to many purposes, it is essentially a constant speed machine and, as such, difficulty amenable to variable speed control. Yet there are many cases in which hoisting, machine tool, traction or similar work is to be done, where a polyphase alternating current can be more conveniently and economically used either on account of unsatisfactory commutation or because of the characteristics of the power system.

No universal solution of this problem of speed adjustment has yet been devised, each method having some condition limiting its application. In general, speed control may be either internal or external to the motor. Internally this may be accomplished by changing the number of poles, giving rise to the multi-speed induction motor. Externally it is possible to vary either the frequency or the voltage and thus influence the speed.

The frequency may be varied by use of a frequency-changer set, by employing a separate generator for each motor, or by operating two or more motors in concatenation on the same load. Frequency-changer sets are too costly and too bulky to be practicable for this purpose alone; a separate generator is usually out of the question, and concatenation or tandem operation is obviously impossible with a single motor.

The voltage may be varied either by rheostat or compensator control of the stator or by rheostat control of the rotor, assuming that the stator is the primary circuit and the rotor the secondary. For a given torque the slip of an induction motor is approximately inversely proportional to the square of the primary voltage. While this method is frequently employed, particularly in places where there is danger of explosion or fire from an electric spark, it gives poor speed regulation and low power factor and efficiency at the lower speeds. The cost of a compensator is sometimes prohibitive, being about one-fourth that of the motor, while the results of primary control with rheostats are not as satisfactory as with compensators. The method most generally adopted is rheostat control of the rotor circuit, which though inefficient at low speeds, is at once cheap and simple.

From this brief survey it is seen that the three-phase induction motor cannot yet be called as satisfactory an adjustable speed machine as is the direct current series motor or even some of the single-phase machines. All the methods of controlling the speed, except the concatenation and the pole-changing, are wasteful, and these are limited to a few definite speeds. The others are make-shifts, complicated, unreliable or expensive, which are tolerated only because of the manifold compensating advantages of alternating as compared with direct current.

PERSONALS.

W. S. Heger, California manager of the Allis-Chalmers Co., is at Los Angeles.

Thomas Mirk, of Hunt, Mirk & Co., returned to San Francisco last Monday from a trip to Tacoma.

George Davis, of the Davis Electric Company of Santa Cruz, was a recent San Francisco visitor.

L. F. Youdall of the Electric & Machine Equipment Company of Stockton, motored to San Francisco this week.

L. M. Hancock, who is interested in electric lighting at Fortuna, Cal., was a visitor at San Francisco last week.

C. P. Baird, manager of the Lompoc Light & Power Company, of Lompoc, paid a visit to San Francisco during the past week.

Geo. B. Ferrier, Jr., sales manager for A. L. Ide & Sons, Springfield, Illinois, manufacturers of the Ideal engines, is at San Francisco.

Eward L. Brayton, president and general manager of the Pelton Water Wheel Company, recently went to Southern California on a business trip.

F. W. Gay, mechanical engineer with J. G. White & Co., is at Bakersfield installing a new steam plant for the San Joaquin Light & Power Company.

E. A. Quinn, of the Allis-Chalmer's Co.'s sales department, has returned to the San Francisco office, after a trip through the mining camps of Nevada.

J. V. Kunze, Eastern manager of the Pelton Water Wheel Company, who is making a tour of the Pacific Coast, is expected to arrive at San Francisco next week.

W. B. Moore, formerly district superintendent of the Pacific Telephone & Telegraph Company at Seattle, has been made division plant superintendent at Los Angeles.

C. C. Hillis, manager of the Electric Appliance Co., San Francisco, was elected Vulcan at the eighth annual meeting of the Rejuvenated Sons of Jove at Birmingham, Alabama.

James D. Schuyler, a hydraulic engineer of Los Angeles, who is interested in electric power enterprises on the Pacific Coast and elsewhere was a recent San Francisco visitor.

G. R. Field, assistant general manager of the Great Western Power Company, recently returned to his San Francisco office after paying a visit to the site of the Big Meadows dam.

J. P. Dunphy, who was formerly district superintendent at San Francisco, has gone to Seattle, where he will have the same title with the Pacific Telephone & Telegraph Company.

Joseph H. Handlon, claims agent of the United Railroads, returned to San Francisco last Saturday, after attending the sessions of the National Street Railway Association at Atlantic City.

M. C. Hixson, formerly with the meter department of the Pacific Gas & Electric Co., is now acting as chief electrician at Stanford University in conjunction with some technical studies which he is pursuing.

J. H. Leary, for many years chief dispatcher for the Southern Pacific Company at the Oakland mole and the Third and Townsend depot, has been appointed superintendent of the Central California Traction Company with office at Stockton, Cal.

O. C. Pratt, president of the Indian Valley Light & Power Company, will leave for Quincy, November 7th, to attend the annual meeting of the stockholders of the company, which operates a hydroelectric plant at Greenville, Plumas county. Several extensions of the power lines are projected. The company's San Francisco office is at 1108 Crocker Building.

Leon M. Hall, electrical engineer, spent last week at Los Banos in connection with an irrigation project, involving the construction of a system of ditches and a dam which will form a reservoir having an area of 100 acres.

H. A. Lardner, manager of J. G. White & Company's Pacific Coast branch, has returned to San Francisco after inspecting the work on the great dam at Crane Valley, which will be completed about January 1, for the San Joaquin Light & Power Company.

Leslie R. Coffin has been appointed manager of the Whatcom County Railway & Light Co. of Bellingham, Wash., in which capacity he has been acting since the appointment of the former manager, L. H. Bean, as manager of the Tacoma Railway & Power Co.

C. H. Gaunt, general superintendent of the Western Union Telegraph Company's Pacific Division, recently returned to his San Francisco headquarters after a trip to New York, H. F. Dodge, division commercial superintendent met Mr. Gaunt on Puget Sound and came south with him.

Harry L. Worthington has accepted the position of superintendent of distribution with the United Light & Power Company, effective November 1. He has occupied a similar position in the electric lighting department of the San Francisco Gas & Electric Company during the past four years.

R. Nakakoji, vice-minister of the department of communication of the Japanese government, which has charge of the imperial railroads, telephones and telegraphs, accompanied by two secretaries, H. Suzumura and S. Uchida, was entertained at Seattle this week while returning from England to Japan.

J. M. Howell, the hydraulic engineer who did much of the preliminary work for the Great Western Power Company's hydraulic system at the Big Bend of Feather River and at Big Meadows, recently returned from a stay of several years in Japan and will reside permanently at Berkeley.

S. N. Griffith of Fresno who was formerly at the head of the Fresno Traction Company, recently spent some days at San Francisco. He has completed the surveys for an electric road from Fresno to Clovis, and on its completion he purposes to build a connecting line, fifty miles in length, via Centerville and Reedley to Orosi.

TRADE NOTES.

The Standard Underground Cable Company has opened a branch office at 707 Electric Building, Cleveland, Ohio.

Arthur S. Bent Co. of Los Angeles recently installed 12 miles of 36-in. concrete pipe from Barker Meadows to the Kossler power house of the Central Colorado Power Company.

John Ross Wade, of Chico, has purchased a complete golddredge equipment from the Westinghouse Electric & Manufacturing Company. It includes a number of 2200 volt induction motors ranging from 150 h.p. down to 30 h.p. Special precautions have been taken to prevent injuries to the men operating the dredge. Each motor is equipped with a magnetic brake and has an individual circuit breaker. The scene of the operations is to be at a point 15 miles north of Chico.

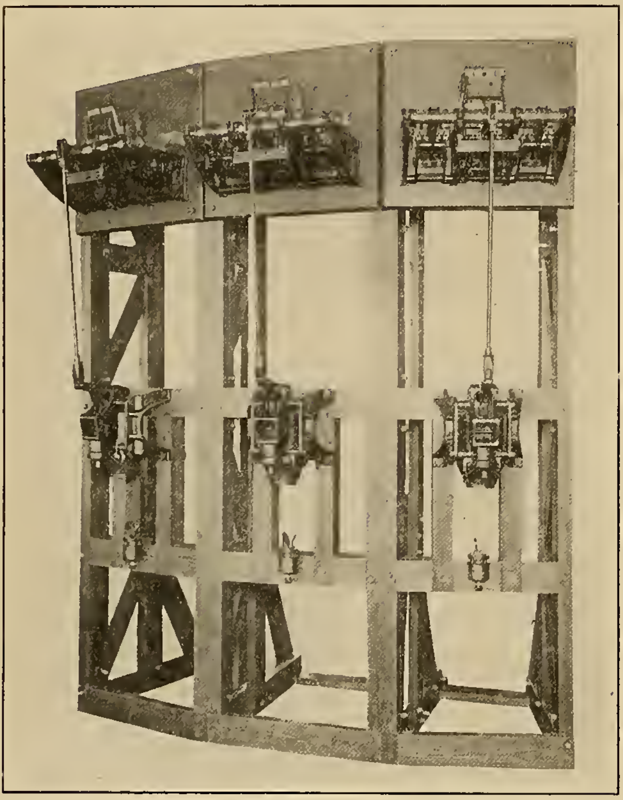
The Westinghouse Electric & Manufacturing Company report the closing of a contract for a complete electrical equipment for the operation of the Valley Ice Company's large new ice plant at Bakersfield. A number of 440-volt induction motors, ranging from 200 h.p. down to 10 h.p., will be installed. The ice-making capacity will be 300 tons per day and the plant will be ready for operation next February. The Valley Ice Company's plant at Fresno, which began operations July 1, is said to be the first in the United States to be operated throughout by electric motors. Steam engines were used to drive the ammonia compressors in the past. Westinghouse motors are used throughout this plant. The compressor is belted to a 500 h.p. motor.

INDUSTRIAL

A LARGE ALTERNATING CURRENT CIRCUIT-BREAKER INSTALLATION.

The construction of a circuit-breaker for use on heavy alternating current circuits presents a somewhat difficult problem to the designing electrical engineer. To ensure the distribution of the current uniformly throughout the various parts of the breaker and the avoidance of skin effect, energy losses in heating, etc., requires very skillful designing.

The largest alternating current circuit-breaker yet built is installed in the worsted mills of the American Woolen Company at Lawrence, Mass., and protects a 600-volt, 40-cycle turbo alternator. It is a triple-pole solenoid operated,



12,000 Ampere, 600 Volt Circuit Breaker

type C, Form K-2 breaker, built by the General Electric Company, and has a current carrying capacity of 12,000 amperes continuously without overheating.

If a circuit-breaker for use on heavy alternating current circuits of 6000 amperes and over were built on the lines of usual direct current construction it would not perform its work satisfactorily and would heat to a dangerous degree in service. To avoid this, special construction must be employed.

In the design of the circuit-breaker in question, a large amount of radiating surface was provided and uniform distribution of the current throughout the various parts was ensured by subdividing the contact brushes and the studs of each pole into six sections, each section insulated from the others. Each pole of the circuit-breaker is operated by a separate solenoid mechanism so connected that the entire triple pole breaker is controlled by a single control switch on the switchboard panel. The open and closed positions of the breaker are indicated by pilot lamps located at the controlling switch.

To obviate the necessity of opening an arc at the control switch, the circuit of the closing coils is opened by relays located near the circuit-breaker after the latter closes. The circuit-breaker trip coils are opened by auxiliary switches on it, which open when the breaker itself opens. The device is made automatic by the use of current transformers and relays. The circuit-breaker, solenoids and control relays are mounted on specially designed hard wood supporting framework made to conform to the perimeter of the turbine to which the framework is secured.

The breaker has now been in service for several months and is operating satisfactorily. This, however, is not more than was expected because, before shipment, after being well tried out for purposes of adjustment and to discover any weak points in construction, the breaker was subjected to thorough mechanical endurance tests under conditions much more severe than it could possibly be expected to endure in actual service.

BENJAMIN LARGE BASE RECEPTACLES.

The advent of the new 400 and 500 watt Mazda lamp has created a demand for suitable sockets and fixtures with large base receptacles. To meet these new conditions and thus remove the chief obstruction to their commercial introduction, the Benjamin Electric Company have designed, and are now placing upon the market, a number of sockets and receptacles especially intended for large base lamps.

No. 69—Multiple.

No. 79—Series Film Cut-out.

The accompanying illustrations show two sockets. The No. 69 is intended for use on low-voltage circuits not requiring cut-out or short-circuiting mechanism. It has spring center contact, wires lead in the sides, and the binding screws are accessible from the central opening. No. 79 is a two-piece series cut-out socket with short-circuiting center contact for high-voltage street-lighting circuits. It has side connections and will receive wires as large as No. 6. Both of these are adapted for attaching to a surface or bracket by means of screws passing through the base.

TRADE NOTES.

R. P. Starkweather, pole line contractor, San Francisco, is installing 25 miles of trolley line for the Oakland Antioch Electric Railway Company between Bay Point, Lafayette and Martinez. He is also overhauling 25 miles of the Snow Mountain Power Company's lines at Ukiah.

Hunt, Mirk & Co., representing the Westinghouse Machine Co., report that the San Diego Electric Railway Company, has purchased a 1000 kw. exhaust turbine generator fitted with the Westinghouse-Melville-MacAlpine reduction gear. This generator set is the first of that type sold on the Pacific Slope. The rotor of the turbine makes 3600 r.p.m., while the 600 v. d.c. generator has a speed of 514 r.p.m. The agents say that there is a big field for such d.c. turbo-generators in connection with the operation of centrifugal pumps in California.

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—The Independent Electric Company have incorporated for $100,000. E. W. Hardy, 405 Chamber of Commerce Building, Portland, is interested.,

LOS ANGELES, CAL.—The Pacific Ocean Power Company of California has been incorporated by W. N. Brassington, C. J. Stoneham and G. D. Snyder, with a capital stock of $10,000.

OLYMPIA, WASH.—Incorporation articles have been filed by Chas. C. Gentry, Walter Strange and Arpad Tokey for a Monorail Railway Company to connect Bellingham, Port Angeles, Irondale and other cities. The company is capitalized at $7,000,000.

FINANCIAL.

VALE, ORE.—The taxpayers have voted to bond the city in an additional sum of $33,000 to build a gravity water system from Willow Springs, 12 miles south.

OCEANSIDE, CAL.—The City Council has passed an ordinance providing for the issuance of bonds of $20,000 voted for on September 14th for the construction of a water-works system in this city. The bonds will be 40 in number and of $500 each, bearing 5 per cent interest per annum, payab'e semi-annually. Bond No. 1 will run one year; No. 2 two years; No. 3 three years, etc.

TRANSPORTATION.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will extend its Cazadero line 3½ miles.

SALEM, ORE.—The Santiam Development Company has applied for a franchise here and proposes to build an electric line between this place and Stayton.

LOS ANGELES, CAL.—The Los Angeles Pacific Railway Company will at once put 1400 more men to work on the tracks between Los Angeles and Hollywood relaying and paving that line.

LOS ANGELES, CAL.—A two mile extension of the Los Angeles Railway Company's system is announced by which Thirty-ninth street will have a street car line trom McClintock street to Western avenue, connecting it with the University line.

POCATELLO, IDAHO.—Judge A. Z. Watscn of Chicago, representing a syndicate of capitalists of that city, states that an electric railway is contemplated from American Falls to Malad, Idaho. It is stated that the proposed line has been surveyed and that a company is being formed offering stock for sale.

PORTLAND, ORE.—F. A. Nelson, the inventor of an automatic street car fender and who has been in the city for several months in the interests of the concern manufacturing it, announces that he contemplates building a plant in this city for the manufacture of the fenders to be used on the Coast. He will immediately secure a site and build a factory.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has adopted sketches prepared by Architect C. E. Shattuck for new passenger station to be erected at Pine and Seaside Boulevard, Long Beach, and working drawings will be started at once. The construction will be steel and brick with concrete foundation and pressed brick exterior. There will be a ticket office, curio store, checkroom, ladies' restroom, cafe and kitchen on first floor.

SACRAMENTO, CAL.—The Northern Electric Railroad will completely circle the city with its tracks in the near future if the plans as outlined last week to the City Board of Trustees by Attorney A. N. Seymour meet with the approval of the municipal governing board. Seymour made application for a franchise granting the right to the company to lay its tracks on I street from Seventh to Second, on Second from I to M and on M street to the alley between Second and Front.

FRESNO, CAL.—S. N. Griffith announced at the regular bi-weekly meeting of the real estate board that he has financed and will shortly build an electric railroad between this city and Clovis. He stated that he has secured about three-fourths of the right of way for this road, and that the beginning of actual construction will follow upon the securing of the remainder of the right of way, which he expects soon to have accomplished. He further mentioned without details that he will shortly announce plans for another interurban electric road to run out about 50 miles from Fresno, but declined to state the route and destination of this line. During the past summer he secured financial backing for the construction of an interurban railroad system, of which the Clovis road will be a starter. He estimates that the total expenditure on this enterprise, complete, will be about $2,000,000. The expense of the work of construction he figures at $30,000 a mile complete with rolling stock, and other equipment.

OAKLAND, CAL.—Several new street railway franchises were applied for by the Oakland Traction Company at a recent meeting of the City Council. The most important is for a line on Clay street from Eighth to Seventeenth street, connecting the San Pablo and West Eighth street lines. The company would also like to extend its Thirteenth street line from the present terminus at Washington street west along Thirteenth to Market and thence north to the tracks at Fourteenth and Market. The company also asks to be permitted to extend its Thirteenth street line from Thirteenth and Washington streets on a curve to connect with Washington street. A franchise is asked for a line beginning at Market street and San Pablo avenue running north across San Pablo avenue to Market street and thence north on Market street to Fifty-fifth street and the Key Route tracks. An important extension asked for is that beginning at Hopkins street and Thirty-fifth avenue, known as the Redwood road, running northwesterly on Hopkins street to Peralta avenue, thence southwesterly upon and across Peralta avenue to Hopkins street northwest of Peralta avenue and thence northwesterly along Hopkins street to the company's tracks in Hopkins street and Fruitvale avenue.

LOS ANGELES, CAL.—All the city lines of the Pacific Electric Railway Company, with their entire equipment, have been purchased by the Los Angeles Railway Corporation for about $12,000,000. The deal is one explanation of the Los Angeles Railway Corporation's recent increase of capitalization from $6,000,000 to $20,000,000. The absorption of the so-called red lines by the yellow means universal transfers, and is expected to be of great benefit to the public, because the buying company will make many improvements and additions, and bring the service up to its own high standard. The system acquired was formerly that of the traction company built by the Hooks, afterward bought by Huntington's interurban company and later absorbed by the Pacific Electric. It reaches far in all directions with a few tracks, and will be a valuable groundwork for the Los Angeles Railway Corporation's constant construction of feeders. The new roads ac-

quired will make the mileage of that big corporation in excess of 350. H. E. Huntington is president and virtual owner, though most of the stock was issued to his son, Howard E. Huntington, the general manager. The elder Huntington also retains control of the Pacific Electric, which is directing its energies to further fields, and is expected to stretch its 600 miles of trackage to 1000 within two years.

ILLUMINATION.

LIVE OAK, CAL.—The Live Oak and Encinal Electric Light Company is making preparations for an extension of its line north of Live Oak.

SAN FRANCISCO, CAL.—The Pacific Power & Light Company has declared an initial dividend of 1¾ per cent on the preferred stock, payable November 1, to stock of record October 24.

ELLENSBURG, WASH.—The bill of the Olympic Foundry Company of Seattle to furnish 14 cluster light poles complete with globes at a cost of $46.90 each has been accepted by the council and the company will ship the lights.

OCEANSIDE, CAL.—E. V. Griffes, local manager of the Oceanside Gas & Electric Company, is figuring on electric wires to Fallbrook, where he will furnish that town with light. The system will cost about $4000 and Mr. Griffes will probably install it.

CLAYTON, N. M.—The city water and electric light plant owned by Territorial Land Commissioner Robert Ervein, now of Santa Fe, has been taken over by the city board of Clayton. Bonds for $50,000 will be voted as soon as an election can be called and an entire new system of water and electric lights will be built within the coming year.

NEWPORT, CAL.—The City Clerk will receive sealed bids up to December 12th for a franchise to erect poles and uprights in the public streets and alleys of this city and to equip poles with brackets, cross-arms and other means and appliances for placing and stringing wire and cables for the conveying and transmission of electric energy for light, heat and power.

HANFORD, CAL.—Suit has been brought against the city of Hanford by the Hanford Gas and Power Company for the refunding of a $700 franchise tax which was paid under protest in two different years. The case is an attack on the provision of the company's franchise which requires it to pay 2 per cent of its gross earnings each year after the fifth year of operation. The company contents that the city has no right to impose this franchise tax.

BAKERSFIELD, CAL.—B. C. Oliphant of Buffalo, N. Y., manager of the California Natural Gas Company, which was recently incorporated in San Francisco to conserve for domestic purposes the great gas production of the Midway territory, is now in Bakersfield with officials of the Standard Oil Company, which owns the gas wells. He says actual work on the new company's plant will commence early in December. The company already has in the Midway district material ready for laying 30 miles of 4-inch pipe. The central plant will be established on section 26, where the Standard's biggest well is located.

COALINGA, CAL.—Taft's new gas plant is in operation and several places are using the fuel. Other houses are being connected with the mains as rapidly as the work can be done. No lights have yet been installed, as the company wishes to get the receivers into place first to insure the steadiest pressure. The receivers have been shipped, but have been delayed in arrival. The natural gas is brought here through a 2-inch steel main, under a pressure of 300 pounds. The capacity is 250,000 cubic feet per hour, so there is no danger of there not being enough to go around. At the works it passed through valves to bring the pressure down to the required amount.

TRANSMISSION.

WHITE SALMON, WASH.—The Husum Power Company will erect a concrete dam here.

CHINOOK, MONT.—The City Council has taken up the question of building an electric light plant.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will erect a 15,000 h.p. steam plant in East Portland.

HERMISTON, ORE.—B. A. Chisolm of Meadows, Idaho, is negotiating with the city authorities of this place for the erection of a light plant.

TACOMA, WASH.—The Chicago, Milwaukee & P. S. Railway will erect a $5000 power house 80x22 at East Twenty-fifth and Portland avenue.

VANCOUVER, B. C.—The Dominion engineer, J. R. Freeman, has announced that the Vancouver Power Company, may build an 85-foot dam at Coquitlam, providing certain conditions are observed.

CRESTON, B. C.—The International Electric Company of Nelson, B. C., and Portland, Ore., has filed on the water powers of the Pend d'Oreille river and a development scheme to utilize the powers will be inaugurated in the near future.

SPOKANE, WASH.—Mayor Pratt is advocating the purchase of a city power plant. The proposed site if acquired would be located on upper Spokane river, to develop about 6000 h.p. W. Moore, city hydraulic engineer, who has prepared preliminary estimates, states that the proposed plant would cost $500,000.

PORTLAND, ORE.—The Independent Electric Company which incorporated in Multnomah county with a capital stock of $100,000 by H. G. Fleischauer, F. W. Wall and Ernest Hardy has completed negotiations for the purchase of the Hillsboro Water, Light & Power Company and the Haines Light & Power Company, which controls a water-power plant 16 miles from Forest Grove. Plans of the new company contemplate the expenditure of several hundreds of thousands of dollars for improvements and extensions, and consider the extension of the company's power lines to Beaverton, Orenco, Cornelius, Diley, Gaston and cities along the line of the Oregon Electric between Beaverton and Forest Grove. B. M. Boykin, who has an office at No. 502 Fenton building has been made president of the new corporation. Light and power will be supplied to all regions within a radius of 20 miles from the site of the Haines plant.

SAN FRANCISCO, CAL.—The effort to merge several power companies in this State, which has been the objective of Byllesby & Co., a Chicago bonding house, for several months, has failed, according to the statements of several members of these companies. It was reported that this projected merger was to be in the interest of the General Electric Company which is said to be a creditor of these small companies for large sums, that the Byllesby & Co. were acting for the General Electric. The companies mentioned as having been approached on the subject are the Stockton Gas Company, the Humboldt Light & Power Company, Haywards Gas & Electric Company and the Northern California Power Company. H. H. Noble, president of the last-named company, said that several weeks ago a broker had asked him for an option on the properties, and that the option had been given for a short period. He said the price was evidently too high, as no use was ever made of the option. The only company which Byllesby & Co. succeeded in bonding was the Humboldt Light & Power Company, with a plant on the Trinity river.

BAKERSFIELD, CAL.—Preparations are being made for the shipment of the material for the power line through the oil fields of the San Joaquin Light and Power Company to this city. The work of construction will begin from this end of the

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line within the next two weeks. The plan is to run a loop from the power plant near Fresno through the oil fields, by way of Bakersfield, returning through Coalinga. This vast undertaking will require some time to complete, but when the line has been built the oil companies will be assured of steady power under all conditions. The work of construction will begin simultaneously at Fresno and at Bakersfield, the Fresno crew working toward Coalinga on the loop while the Bakersfield crew will build the line between this city and Moron. The two construction gangs will meet somewhere in the oil fields, completing the loop. The company will then have the use of four power plants for their own needs and for their customers. There is a 27,000 h.p. plant situated outside of Fresno and another 2500 h.p. plant inside the city. At this city they have the old 2000 h.p. plant in the canyon which was used by the P. T. & L. Co. and the new 2500-h.p. plant in this city which has been completed recently.

SAN FRANCISCO, CAL.—A big power deal was consummated when the Pacific Gas & Electric Company contracted to handle the output of the Great Western Power Company for a long term of years. The negotiations have not entirely closed, according to President Drum of the Pacific Gas & Electric, but they are sufficiently progressed to be only a matter of the exchange of signatures and other formalities. The Great Western Power Company, which has invested about $15,000,000 in its plant, has been producing 40,000 kw. of electric energy for some time, about two-thirds of which has been purchased by the Pacific Gas & Electric Company, as the former corporation has no distributing systems or retail markets for its power. The negotiations were carried on in New York, where the Great Western Power Company has its executive offices, between Edwin Hawley, president of the company, and N. W. Halsey & Co., the financial agents of the Pacific Gas & Electric Company. President Drum has denied that his company guaranteed to meet the dividends on any of the stock of the Great Western Power Company. He added that the Pacific Gas & Electric Company merely contracted to buy at a fixed price whatever power the Great Western Power Company could produce for a long term of years.

WATERWORKS.

WASCO, CAL.—The stockholders authorized the directors to install a complete system of domestic water upon the townsite of Wasco. The cost is given at $1300.

OAKLAND, CAL.—A resolution has been adopted directing the People's Water Company to install double outlet hydrants on East Fourteenth street and on all intersecting streets between Fruitvale and High street.

LONG BEACH, CAL.—The Alamitos Land & Water Company is preparing to enlarge its water system. It is the intention of the company to double the system and extend it throughout the city. New mains will be laid and the reservoir will be doubled.

OAKLAND, CAL.—At the annual meeting of the People's Water Company of Oakland last week the existing board of directors was re-elected by the stockholders. Report of the officers were made and the directors went into executive session to consider matters of future action which are to be made public soon.

SAN FRANCISCO, CAL.—Refusal on the part of the Spring Valley Water Co. to consider the proposition of Mayor McCarthy that the city should purchase the plant of the company for $33,000,000, or even for $35,000,000 as formerly agreed, was made last week at the water conference held in the Mayor's office in the Crocker building. The next conference will be held Wednesday evening, November 9, at the Mayor's office, and will be an executive session, when an effort will be made to reach an agreement.

NEW CATALOGUES.

Catalogue B-19 from the Benjamin Electric Mfg. Co., Chicago and San Francisco is an illustrated reference book on Benjamin wireless clusters and lighting specialties.

Bulletin No. 4778 from the General Electric Company is devoted to the Edison Carbon Incandescent Lamp, which are here rated by the three voltage method and in total watts.

Polyphase Maximum Watt Demand Indicator, Type W for recording on alternating current circuits irrespective of power factor and voltage fluctuations is illustrated and described in Bulletin No. 4768 from the General Electric Co.

Bulletin No. 4765, entitled "Isolated Plant—Direct Current Combination Generator and Feeder Panels," recently issued by the General Electric Company, supersedes the previous bulletin issued by this company on that subject.

Booklet 4024 from the Allis-Chalmers Co. sets forth some of the features of Allis-Chalmers lighting transformers for central stations dealing particularly with the factors of safety, ruggedness, efficiency, weight, regulation and cost.

Dossert & Co. have just issued an eight-page folder which illustrates and describes a number of new Dossert specialties, particularly a new anchor connector for use with strain insulators and a new insulated cover for cable taps.

Bulletin No. 14 from the Century Electric Co., St. Louis, and San Francisco, handsomely portrays Century Single Phase Motors. Supplementing a well written text regarding this repulsion induction motor are a series of excellent half tones showing its construction and its varied application. This catalogue is well printed with tint blocks on each page and is attractively bound in double blue cover.

A bulletin was recently issued by the General Electric Company, entitled "Engine Type Continuous Current Generators, Forms RB and RBO for Lighting and Power." The bulletin illustrates and describes direct current generators for two and three wire systems, from 25 to 250 kw., and for standard voltages.

The General Electric Company has recently issued a bulletin describing the GE Tantalum Incandescent Lamp for general illumination. It illustrates and describes lamps for 100 to 125, and 200 to 250 volts, compares the cost and efficiency of these lamps with those of the carbon and Gem lamps, and contains considerable data of use to those interested in the subject. The number of this bulletin is 4766.

The Westinghouse Electric & Manufacturing Company has just issued its Circular 1098 on the subject of Switchboard Indicating Meters. The publication outlines the cardinal points to be kept in mind in the selection of meters. It describes direct current and alternating current indicating meters, including frequency meters and power factor meters; synchroscopes, and instrument transformers.

The Westinghouse Electric & Manufacturing Company has just issued a revision of its Circular 1118 on the subject of its Type CCL Polyphase Induction Motors. The circular describes the electrical and mechanical features of these motors and shows some very interesting pictures of their applications. The circular also includes some short descriptions of the various starting devices used with squirrel cage induction motors.

Bulletin No. 4775, issued by the General Electric Company, entitled "Type KS Single-Phase Induction Motors," describes a motor offered by the General Electric Company to meet the power requirements of establishments which, for some reason, are unable to secure other than single-phase current. This motor is, in general, adapted to drive geared and belted machinery requiring constant speed with light or moderate starting torque. It is made in capacities of from 1 to 15 horsepower, and wound for 110 or 220 volts, 60 cycles.

JOURNAL OF ELECTRICITY
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Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXV SAN FRANCISCO, NOVEMBER 12, 1910. NUMBER 20

THE GREAT POWER PLANT AT ELECTRA

BY ARCHIE RICE.

Archie Rice

In California snow is converted into electric light. The dazzling white mantle upon her lofty mountain tops flashes forth again by the sea. California sunshine sips vapor from the heaving bosom of the Pacific. The trade winds carry the saturated atmosphere inland. Heated air rising from the great interior valleys buoys up the vapory masses as they pass way overhead. They float gently on till they are checked by the towering ramparts of the mighty divide that walls California all along her eastern boundary. Hovering there the clouds wait till a fall in the temperature relieves them of their burden. To the deep, white masses upon the Sierra crests those clouds then add their myriad of little icy crystals.

In the Power House at Electra.

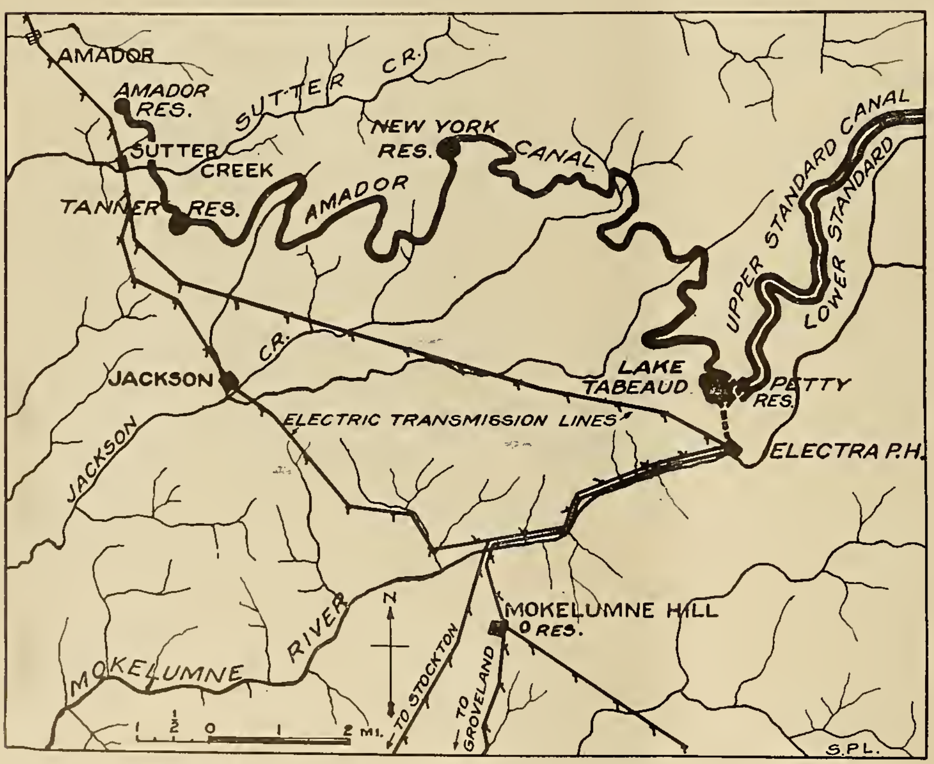
Again California sunshine brings a change. The rainy season is over. Drying valleys are athirst. Steep mountain-slope streams are dwindling. And then that jagged white skyline begins to melt and renew the springs.

The gleam in that mountain-top snow, ten thousand feet in the air, starts on its way to be transformed into the glow of artificial light. After a downward journey of more than two hundred miles it appears again, spangling the darkness about San Francisco Bay with tens of thousands of lights, picking out the cities in detail and making them sparkle in the night like a fairyland strewn with brilliants.

You get the wonderful effect of it when gazing down from the summit of Mount Tamalpais, 2600 feet above the Golden Gate. The accumulated energy that makes these city lights has come from snowy summits four times as high as Tamalpais.

No other hydroelectric system in the world more

Showing the Location of the Company's Alta, Auburn, Newcastle, Folsom and Electra Power Plants and Their Water Sources and Canals.



Map Showing the Immediate Surroundings of the Electra Power Plant.

graphically demonstrates the various stages of this mysterious evolution of a snowball into an incandescent light than does the giant generating plant at Electra. It is on the Mokelumne River in Amador County, near the middle of the eastern part of California, a dozen miles from the old mining town of Jackson.

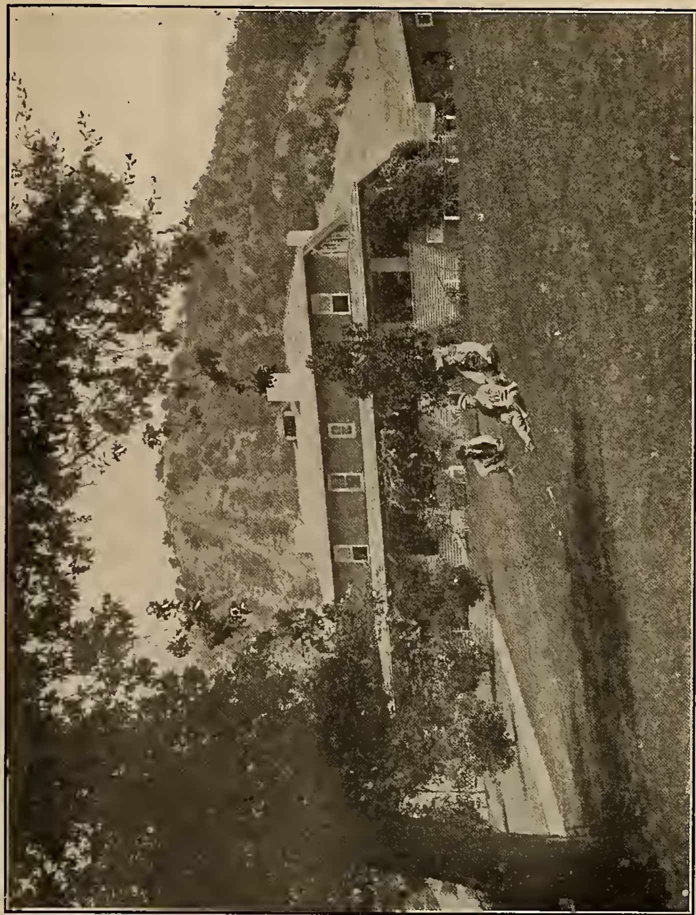
A little to the southward of Take Tahoe is Alpine County. It is so sparsely peopled that, all told, its inhabitants would form a village of only a few hundred people, and mostly Indians at that.

Alpine County is rightly named. Its back is bumped and its sides slope east and west from the divide. Terraced high along its western slopes are natural basins filled with snow-water.

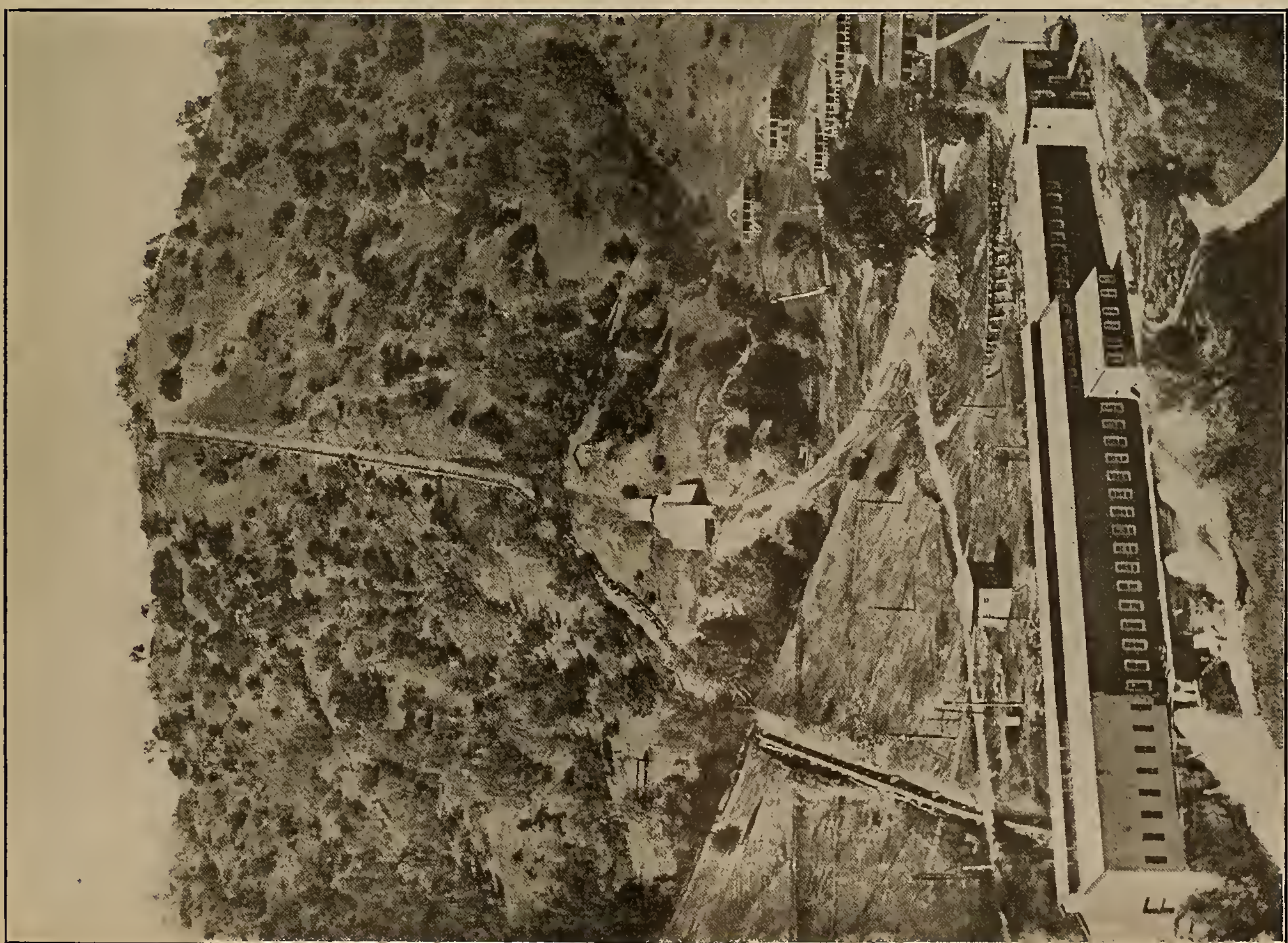
That is the country of the Blue Lakes. And the Blue Lakes are part of the high, mountain, storage system that supplies the Electra power plant. There are four lakes in that group. They cover an area of from one hundred and twenty to three hundred and forty acres each. They range in depth from twenty to sixty feet and in elevation above the sea-level from 5700 to nearly 8200 feet. They store water for the day of need.

Men stationed at the lakes regulate the outflow into the Mokelumne River according to telephonic directions given them each day by the superintendent at the power plant. He calls for whatever water-flow he needs, and he gets it. The lakes are eighty miles from the power plant. The river for some fifty miles serves as a channel outlet for the lakes. Then ditches and canals tap the river and skirt the mountain ridges and bring the lake water gradually along for twenty miles to the place where it is finally shot down through

The Original Electra Power Plant.



The Clubhouse, Known as the Standard Hotel, with John A. Britton and Friends on the Lawn.



General View of the Electra Power Plant on the Mokelumne River in Amador County, California, where 28,100 Electrical Horsepower Is Generated.

big steel pipes to drive the impulse wheels at Electra. In those twenty miles the river drops about sixteen hundred feet. But the man-made canal uses a very gentle gradient. When the canal water finally reaches the forebay reservoir on a ridge overlooking the river, it is then more than 1450 feet higher than the river water flowing past the power house that stands down below on the bank of the Mokelumne. In falling from that height the diverted water produces unbelievable energy, tremendous power. It flows down through the pipes at a steep angle. The height of the fall produces an amazing hydraulic force. From the four-inch nozzles under the power house the liberated jets flare big and shoot two hundred yards out into space, driving furiously at a speed of three and four-tenths miles a minute.

They have torn up the rock-ribbed river-bed as the stream from a garden hose might gutter out soft loam. When they emerge from the building they are already swollen to the thickness of a man's body. They flare bigger as they slip through the air—rocketing, hissing, moaning, humming, thundering with a force that fascinates the spectator.

The lofty drop is the favorite California method of producing water-power. In the east they slightly divert a river to make a fall of a few feet, relying on a great volume of water to create the force. But the steep slope of the streams in the Sierras and the convenient chances for reserve storage permit the use of much less water and the creation of an artificial fall of many hundreds of feet to produce enormous power.

That battering force at Electra strikes into the steel water-wheel buckets like a hurricane into a windmill and revolves them faster than the eye can follow the movement. The ponderous shafts connected to these water-wheels turn the seven huge electric generators.

Thus the snowflake becomes the electric spark.

The collected energy stored up in these mountain lakes has come down with a final rush to the power plant and been suddenly converted into a continuous force of 28,100 horsepower. Can you imagine the horse equivalent of that power? that many animals pulling at some great load? Close-coupled and hitched two abreast, the team would stretch out nearly twenty-seven miles!

Produced at a potential of 2300 volts, that gigantic electric force is passed though eighteen transformers and its potential raised to 60,000 volts. And at that force it thrills silently and unseen through big copper wire, over hills and across streams, traversing valleys and spanning channels along a pole-line route that runs through Stockton and Mission San Jose, and then diverges with a branch up to Oakland, another round the Palo Alto side of the bay to San Francisco, and a third to the seacoast in San Cruz County, a maximum transmission distance of one hundred and forty miles.

Electra as a power plant was an evolution from a different purpose. Back in the year 1871 the Blue Lakes Water Company was formed to supply water to the gold mines in Amador county. A ditch system more than eighty miles in length was built to convey the lake water to where it could be sold to the miners. For nearly thirty years the enterprise was very profitable. Then hydraulic mining was forbidden by law because of the muddy debris that was choking up the navigable streams. And old producing quartz mines began to wane. The water company's business accordingly dwindled. There was lack of consumers.

Along in the nineties there came to California a tall, rather esthetic-looking young man who was welcomed in the highest society. He was the proud descendant of a royal Polish family that had maintained its titles despite the expatriating influence of Russia's grip on Poland.

Prince Andrea Poniatowski cared for other things than social functions. He had the business instinct of the promoter and a personality that could interest investors in his schemes.

He conceived the idea of buying up a lot of those old abandoned mines in Amador county and consolidating them under a single management that they might be worked for a profit. And while he was studying out the situation he hit upon another idea. Why not take water from that Blue Lakes Water Company's ditch and drop it down at a convenient point and use the fall for a hydroelectric plant?

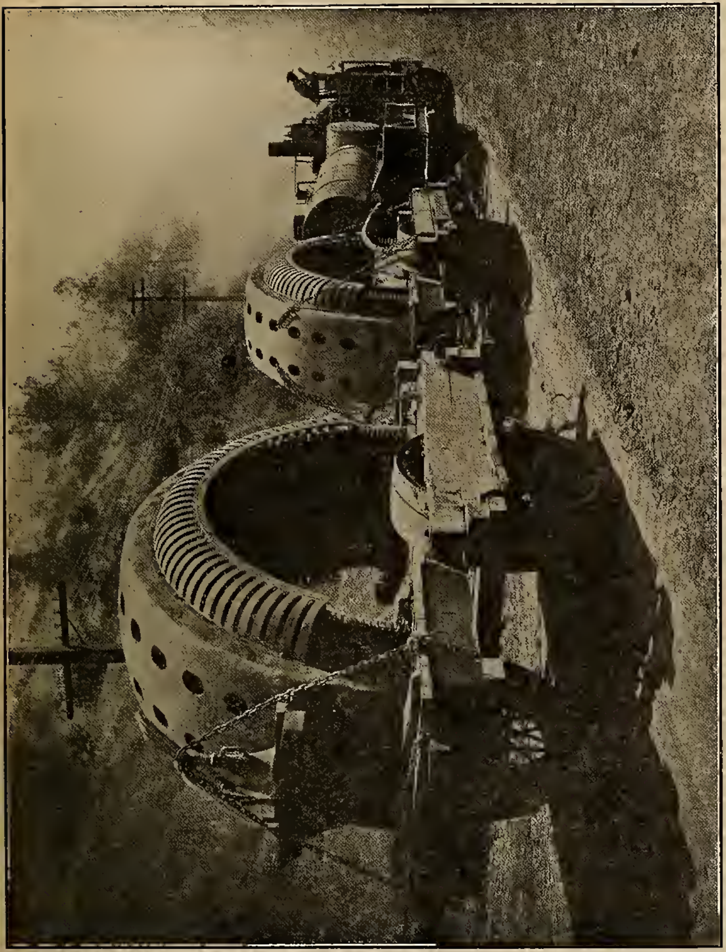
So he started the original Electra power house. It was located on the Mokelumne River about three miles downstream from the present plant. It got its water from a ditch flowing along the ridge at an elevation of about a thousand feet above the power house. It was his original intention to wire this electric energy to his mines and reduce the cost of their operation.

But before that little plant was completed Poniatowski had still another idea. Why not buy out the whole Blue Lakes Water Company in its condition of business decline and build a big power plant and transmit electric energy way down to San Francisco, a distance of one hundred and ten miles? There was no precedent at that time for any such long-distance transmission. His was a daring plan. But he interested investors, bought the water company, and formed the Standard Electric Company of California.

The best engineering skill in the whole country was sought for advice and plans. Nothing was adopted that was not feasible. Practical ideas were everywhere incorporated into the scheme. After the company's own engineers has figured out the possibilities and the costs the Stanley Electric Manufacturing Company of Pittsfield, Massachusetts, proposed the then amazing plan of operating the power lines at 50,000 volts, and promised such a monetary saving that the contract was awarded to that company for the machinery.

So careful were the builders of the big plant in making sure that their ideas were feasible, that the energy could be transmitted more than one hundred miles when the arrangements should all be completed, that they took four years for the work. Every step was a certain one. So sure were they of successful accomplishment that they contracted to furnish certain power to certain prospective consumers on a certain date.

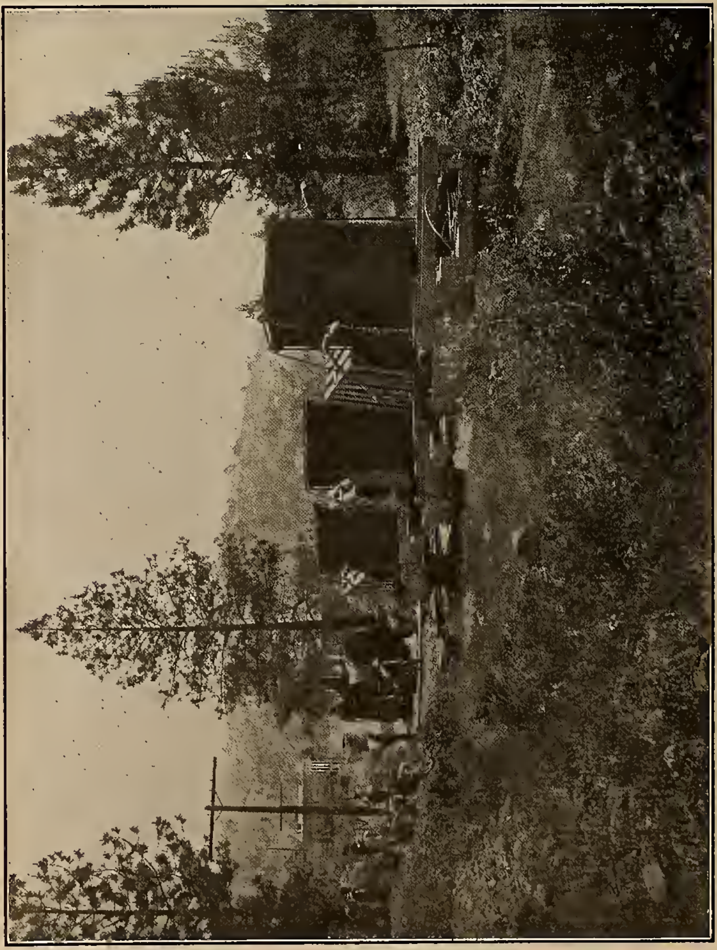
While the builders of Electra were taking time and infinite precautions to guard against failure the big Colgate power plant was started and built in a hurry



Traction Engine Hauling Armatures for the 5500-Kilowatt Generators.

The Shaft of One of the 5500-Kilowatt Generators Being Hauled Near the Electra Power House, With Horses and by Cable.

Swinging Sections of No. 3 Pipe-Line From a Ten-Mule Wagon Into Place With a Derrick.



A Traction Engine Hauling Three of the 1250-Kilowatt Transformers Between Jackson and the Electra Power Plant.

by John Martin and Eugene de Sabla. They mapped out a power-line headed for Oakland and did the amazing thing of spanning the Straits of Carquinez with aerial cables more than two hundred feet above the water and some 6000 feet long. Thus Colgate beat Electra to the honor of being the first California mountain power plant to send its energy down into the cities about the bay; achieved even a greater transmission distance than Poniatowski had planned for Electra.

At first the intention was to bring the Electra power lines down through Stockton to the bay, and then across to San Francisco on poles driven in the shallower water far to the southward of the ferry crossings. But the United States government would not consent to the planting of poles across the bay. So the line was led through the hills to Mission San Jose and forked there up both sides of the bay by land.

It was estimated that the storage capacity of the Blue Lakes and the associated reservoirs owned by the company in the high Sierras would keep the Electra plant running for a period of one hundred and fifty days if necessary. And that was time enough to carry it through the longest dry season ever known in California's history.

A great force of workmen was sent into the mountains to repair and enlarge the aqueducts and carve the way for the big plant. There were four construction camps with from one hundred to three hundred men in each. Those were great times in 1901 for the contractors! They exploited the workmen for their own gain. Each camp had its saloons and its gambling outfit. Men were paid in cash, and they were encouraged to spend freely at the camp. Those that did not patronize the bar were considered undesirables and eliminated. This sort of thing went on till J. Frank Pierce happened to go up into the mountains. He is a prominent Mason, well known throughout California. He was one of the officials of the Standard Company. He had the liquor at every camp dumped out. He made them throw away the crude kitchen ware. He installed a new order of things. He announced that men should have a chance up there in the mountains to save some of the money that they earned; that many purposely sought employment far from towns that they might avoid drink and save their earnings. And from that day on the contractors had to forego the exploitation of the workmen as a side profit.

Twenty miles upstream from the Electra power house there is a concrete dam across the Mokelumne River. There a flow of 5000 miner's inches is diverted into the Standard ditch, which is built along the mountain side to a point opposite the power house. This ditch empties into the petty reservoir, which is the forebay from which the three original pressure pipes carry water down to the plant, a pipe-line distance of about 3600 feet. This is the source of the high-head that operates the five original generators of 2000 kilowatts each.

The petty reservoir is a long, narrow gash partly behind the crest of the ridge and covering an area of about two or three acres to a depth of six or eight feet. From near the inlet end of this little reservoir a flume branches westward carrying the water to the mines in Amador City, Jackson, and Sutter Creek. Along that ditch system are three minor reservoirs holding 4,640,000 cubic feet to maintain the supply to the towns.

When the demand for electric energy grew beyond the original expectations of the California promoters of power plants Electra prepared to enlarge its generating capacity.

A second canal, called the Amador ditch, was built, taking water out of the river at a point about two miles below the first one. This canal practically parallels the course of the earlier aqueduct, winding along below it on the mountain side. With this additional flow it was intended to operate two new generators each of 5500 kilowatt capacity. These machines, really smaller and more compact than any one of the old ones generating only 2000 kilowatts, were installed in a comparatively small addition built onto the southern end of the power house.

The original machines were set diagonally across the power house floor to have them more nearly at right angles to the direction of the water flow in the pressure pipes. But when the two new generators were installed by Frank G. Baum they were placed square with the building and the end of the new pressure pipe was curved to produce a final right-angular strike of water into the buckets.

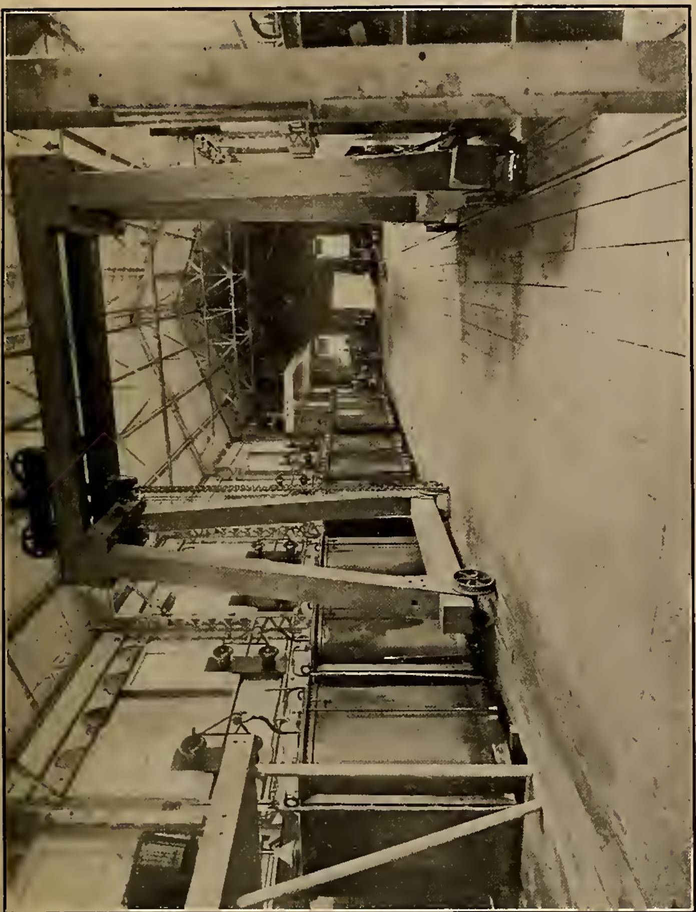
The lower canal produced a fall of about 1250 feet. But there was no way of checking the flow of water or conserving it when it was not needed on the wheels. Nor was there any space on the river side of the mountain where a small storage reservoir could be excavated to receive the surplus flow. There was no way of controlling the flow in either ditch along that twenty-mile route.

A novel engineering plan was then perfected. On the opposite side of the ridge, where descending lateral ridges left a wide ravine, a high earth-fill dam was built and a reservoir created that is known as Lake Tabeaud after the Tabeaud family that had owned the land. This lake has a surface area of about forty acres. It is fed by the excess flow spilling over from the petty reservoir two hundred feet above it and also by the excess flow from the lower canal. But the unique feature of the scheme is that a tunnel 3000 feet long had to be dug through the ridge to make an outlet. Through this long tunnel the water from Lake Tabeaud is drawn off into the low-head pressure pipe. At the outflow mouth of the tunnel there are gates in two of the descending high-head pressure system pipes. Thus water from Tabeaud dam may be turned into them in an emergency. But for the time they operate under the low-head pressure. By this arrangement all the generators in the power house may be run with water from Lake Tabeaud, which has a capacity sufficient to supply the plant for several days, in case of trouble on the ditches from the river.

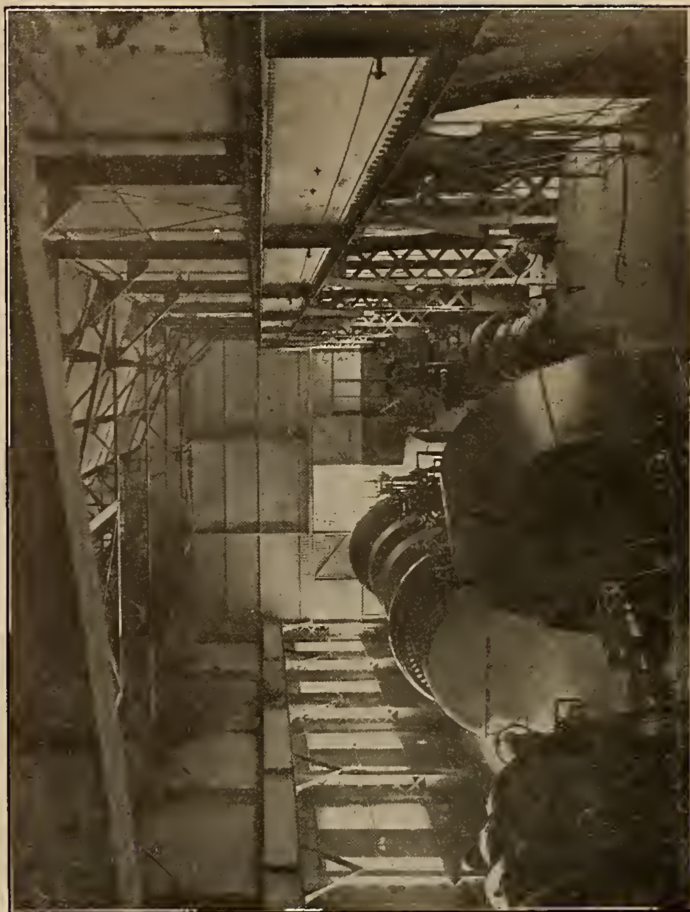
When the great consolidation of central California power plants was effected a few years ago the Standard Electric Company, with its allied water company, became a part of the Pacific Gas & Electric Company and the largest of its generating plants.

The illustrations that accompany this article leave little for verbal description. They tell their own story of the scenery and surroundings.

Only no picture correctly conveys an idea of the

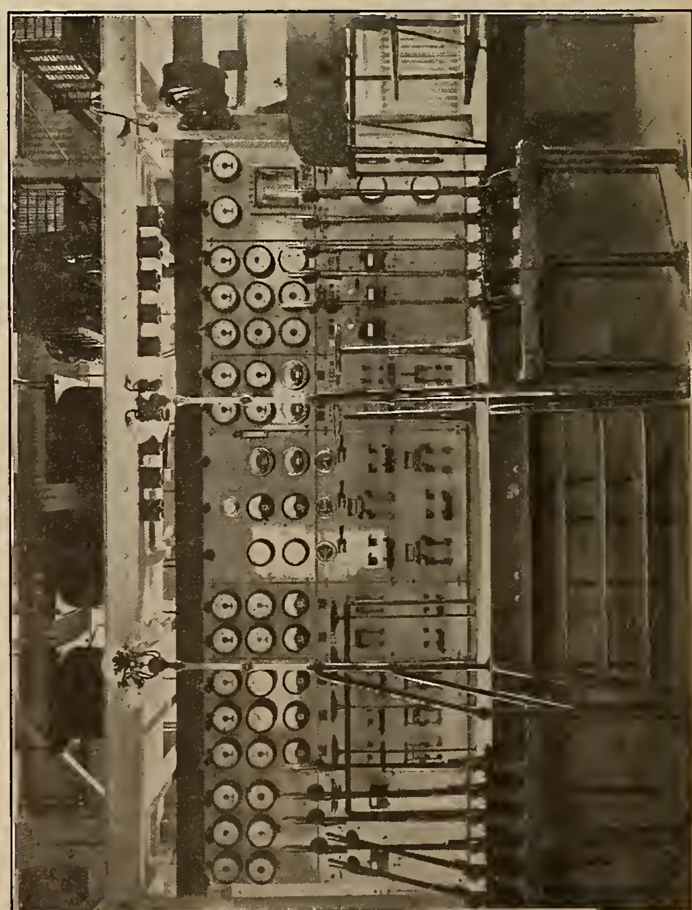


Showing the Transformers and the Machine Shop in the East End of the Power House.



The West End of the Electra Power House, Showing the Two 5500-Kilowatt Generators of the Later Installation and One of the Five (Diagonally Set) 2000-Kilowatt Generators of the Original Installation.

Lake Tabeaud, Over the Ridge Above Electra, Showing the High Earth-Fill Dam.



The Switchboard in the Electra Power House.

steepness of the little tramway. You perch on a toboggan-like car and are quiveringly pulled 2400 feet up to the top of the pressure pipe-lines, half the height of Tamalpais, in seven minutes.

Life at Electra is no miserable isolation. The environment is charming, the scenery inspiring; and ever, day and night, there is the unceasing hum of the generators converting that downrush of hidden waters into 28,100 electrical horsepower.

PHYSICAL DATA, ELECTRA POWER PLANT.

Capacity of storage reservoir	1,079,902,616 cubic feet
Area of storage reservoirs	949.3 acres

Lake.	Elevation-ft.	Flooded Area-Acres.	Depth-ft.	Capacity-Cu. ft.
Twin	8,172	118.3	20	62,063,850
Upper Blue	8,131	343.5	27.5	293,859,766
Lower Blue	8,040	145	35	162,000,000
Meadow	7,773.5	141.2	65.5	244,500,000
Bear River	5,680	161.6	57.5	267,054,000
Taheaud	1,965	39.7	90	50,425,000
Totals		949.3		1,079,902,616

Length of main ditch and flume system	36.75 miles
Flow the second in main ditch system	243 cubic feet
Elevation head	
two pipes each	1,467 feet
one pipe	1,267 feet
Pressure of water the square in.	
2 pipes each	636 pounds
1 pipe	548 pounds
Speed of jets down at the power house	3.4 miles a minute
Number of impulse wheels	8
Capacity of generators	5 of 2000 kw. each; 2 of 5500 kw. each
Total electrical horsepower	28,100
Generating voltage	2,300
Voltage on main line	60,000
Altitude of petty, or forebay, reservoir	2,160 feet
Altitude at power house	693 feet
Size of power house	40 x 270 feet
Material of building	Concrete foundations, steel frame, galvanized iron covering
Plant placed in service	1902

CHEMICAL CONTROL OF OIL GAS MANUFACTURE.[1]

BY E. L. HALL.

(Concluded.)

Miscellaneous Control.

For the purpose of checking up on the control for illuminating and calorific values, and for study of operating conditions, the daily gas analysis is invaluable.

The analysis should be made with a Hempel apparatus. It is fully as rapid as and much more accurate than most of the other different forms of gas analysis apparatus.

A slight modification of the usual burette enables the potash pipette to be permanently attached to one of the openings of the three-way stop cock, effecting a slight saving in time and decreasing the liability of introducing caustic potash into the burette.

There has been considerable controversy during the past few years as to the accuracy and proper manipulation of the nickel cyanide absorption method for benzene vapors. The method of Dennis and O'Neil is probably accurate under the conditions specified by them. The separate estimation of benzene is unavoidable where one desires to calculate the calorific values of the gas.

Fuming sulphuric acid should be used for the ethylene absorption.

The estimation of oxygen should be carried out by means of stick phosphorus.

An acid solution of cuprous chloride for carbon monoxide determination is preferable to an ammoniacal solution because of the liability of the latter to stopping up the capillaries of the pipette. By washing the cuprous chloride with a dilute solution of hydrochloric acid before making up, the same can readily be reduced to a water white solution by means of copper strips.

It is advisable to store a part of the residue from the carbon monoxide determination in the cuprous chloride pipette, and to duplicate the explosion for estimation of hydrogen and methane.

The following figures are in use in this laboratory for the calculation of calorific value. It is well to remember in this connection that heating values which are right at 0 degree F. are wrong at 60 degrees F.

Benzene	3807.4
Ethylene	1588.0
Carbon monoxide	323.5
Hydrogen	326.2
Methane	1009.0

There is no reason why calculated and observed values for caloric value of gas should show any great discrepancies, providing samples for gas analysis and calcrimeter tests are taken simultaneously.

The interpretation of the gas analysis may afford, in the hands of one thoroughly familiar with the manufacture, a very valuable means of operating control.

The presence of a high percentage of carbon dioxide and carbon monoxide is a sure indication of low heats caused by a foul machine or by an excessive water content of the crude oil. The percentage of oxygen should be closely watched in case a small percentage of air is being continuously admitted into the gas for purification purposes. A high percentage of hydrogen shows that the superheater heats are being carried too high.

Gas anaylses should be made occasionally of the blast products and it may be found that a great deal of combustible matter is being allowed to escape for lack of enough blast pressure.

The flue gases from the boilers may be analyzed in the same way for regulating the dampers and condition of the fires.

It is a matter of considerable importance to ascertain the amount of physical impurities remaining in the gas at different stages of the manufacturing process. These impurities, consisting of tar or a tarric pitch and a certain amount of lamp black, must be thoroughly removed by the water and shavings scrubbers before entering the purfiers.

The analysis is conveniently carried out as follows: A calcium chloride U tube is filled with cotton or mineral wool. It is placed in an air bath and connected to a source of suction. The temperature is maintained at 100 degrees C. A current of air is drawn through the apparatus until the tube attains a constant weight. The apparatus is now ready for the test. It is connected up by means of a piece of glass tubing and a rubber stopper as closely as possible to the main, and a sample of the gas is passed through the tube and then into a test meter for measuring the volume of the sample. It is advisable to take a large quantity of gas for the sample. The amount will depend upon the position in the works. More will be required at the inlet to the purifiers than at the inlet to the relief

holder. The tube is again placed in the air bath and dried in the same way to constant weight. The increase represents the physical impurities of the gas, which are reported in grains per 100 cu. ft.

Should it be desired to differentiate into the nature of the impurities, the cotton or mineral wool may be removed from the tube and extracted with alcohol. The loss represents tarry matters. The difference between the weight of the tarry matters and the total amount of the impurities is equivalent to lamp black.

The amount of cyanogen compounds present in the gas may be estimated by bubbling the latter through a series of wash bottles containing a mixture of caustic soda and copperas solution, by which the cyanogen is taken up. The solution is made acid with hydrochloric acid and it may be necessary to remove sulphur with barium chloride before precipitating the cyanogen with ferric chloride as Prussian blue, which is filtered off, washed till free from chlorides, dried, ignited and weighed as ferric oxide, from which the amount of cyanogen is calculated. The same is reported as hydrocyanic acid in grains per 100 cu. ft.

Control of Operating Conditions and Technical Report.

It is often the practice of medium sized works to include in the daily routine of the chemist, the collection of miscellaneous works data, consisting mainly in the observation of temperature and pressures around the works. No better method can be taken for rapidly initiating the young chemist into the operation of the works, without which knowledge the value of his work is greatly reduced. This practice is open to the objection of taking up a great deal of time from the regular laboratory work, but when thoroughly familiar with all the details of the manufacture through daily contact in this manner, the chemist becomes of a great deal of assistance to the foreman or superintendent. He may well be intrusted also with the preparation of the daily manufacturing report. The concentration in the hands of one man, of all the technical data connected with the operation, enables a better study of the same to be made and relieves the operating head of an enormous amount of work which is preliminary to improvements in operating methods.

Valuation of Raw Materials.

The valuation of raw materials in the laboratory may be the means effecting large economy in operation. The most important manufacturing material is, of course, crude oil.

Crude oil is usually examined for specific gravity, viscosity, sulphur contents and percentage of water and sand.

The Beaume scale is generally made use of for reporting specific gravity. It is very seldom necessary to use a more delicate method. In this connection the following corrections for temperature may be found useful. I am indebted to Mr. P. W. Prutzmann, who is generally recognized as an authority on the subject.

TEMPERATURE CORRECTION FOR BEAUME HYDROMETER.

From 10°-20° Be. add or subtract	.065	Be. per 1° Fah. under or above 60° Fah.
20°-35°	.070	
35°-45°	.075	
45°-55°	.080	
55°-70°	.085	

The viscosity of crude oil is really of nearly as much importance as the specific gravity for the reason that the pumping capacity of the plant depends a great deal upon this factor. The efficiency of the burners in the generators may also be affected by a change in the viscosity of the oil.

The percentage of sulphur in crude oil is a matter of the greatest importance. It is the duty of the chemist to subject the oil to examination for this impurity as soon as received in order that provision may be made to cope wth an unduly high percentage of hydrogen sulphide in the gas. The analysis is most conveniently carried out by exploding in a bomb about one gram of the oil thoroughly mixed up with about fifteen grams of sodium peroxide. The residue from the explosion is dissolved in water, made acid with hydrochloric acid, filtered free from lampblack and precipitated with barium chloride in the usual way. The amount of sodium peroxide to be used is gauged according to the appearance of the products of explosion. A residue of oil or the presence of much carbon in the bomb shows insufficient peroxide, while an excess may prevent a successful and complete combustion. The method is a modification of the Sundstrum method for the estimation of sulphur in coal and was written up for an early edition of the "Purifier," a defunct organ of this association, by Mr. P. W. Prutzmann.

The percentage of sulphur in the crude oil bears a definite relation to the percentage of hydrogen sulphide and organic sulphur in the raw gas. It may be stated roughly that every one per cent of sulphur in the oil will be responsible for from 250 to 300 grains of hydrogen sulphide and from 30 to 35 grains per 100 cu. ft. of organic sulphur in the unpurified gas. California crude oil has come under my observation containing three per cent and over of sulphur. An oil so high in sulphur will give rise to from 750 to 800 grains of hydrogen sulphide and nearly 100 grains of organic sulphur per 100 cu. ft.

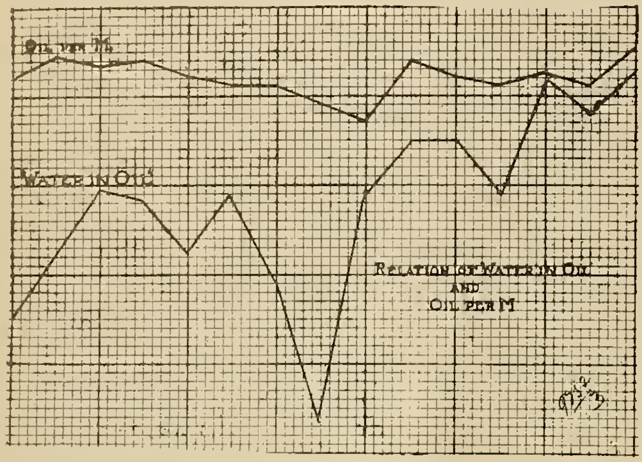
The percentage of water in crude oil is generally estimated by treating with a gasoline in a graduated cylinder and allowing the water to settle out to the bottom where the percentage is read off directly. It is usual also to include in this percentage the amount of sand or sludge which settles out at the same time. The inaccuracy of this method is so great as to make the test absolutely useless as an indication of the amount of water contained in the crude oil. The percentage shown amounts to a third or a half of the actual contents.

Most oil contracts provide for a water allowance of anything over 2 per cent. It is strongly to be urged that the distillation test be specified in all agreements for the purchase of oil, failing which gas companies are likely to be heavy losers.

The distillation method is carried out as follows.

100 c.c. of the sample are measured out in a graduated cylinder and transferred into a distillation flask, which is connected to a condenser. The thermometer may be omitted. The distillate is received into a graduated cylinder of about 15 c.c. capacity, which is drawn out at the foot so that the divisions may be more easily

read. The distillation is interrupted as soon as the water is all off, which is readily noticed by the change in the appearance of the distillation. The water and light oils coming over separate sharply in the receiver and the percentage may very readily be determined within 1/10 of a per cent. The whole operation barely requires a half hour. To avoid breakage the distillation flask may be made of metal. It is advisable in that case to heat the same with a ring burner from the sides. The distillation will then proceed quickly and without bumping.



How much the percentage of water may effect the operation results is not generally realized. Therefore, I show the accompanying diagram illustrating the same. It will be seen how many of the ups and downs in the oil per M. may be traced to the water contents of the oil.

For a study of the nature of the crude oil a complete distillation is interesting, and the residium is somewhat of an indication of the value of the oil for gas making purposes.

Next in importance to the oil is the selection of a good fire-brick which will stand the hard usage incidental to oil gas manufacture. The well known methods for the analysis of clay may be used for fire-brick analysis. The important constituents are silica, alumina and iron. Alumina and silica are of refractory nature, while iron increases the fusibility. It is possible, by analysis, to narrow the choice of a suitable brick down to a few samples, which can then be subjected to practical physical tests to determine their suitability. A trial order, for enough brick to supply one machine, will furnish means for a final valuation under operating conditions. A record maintained of such successive brickings will enable the selection of the best in the market.

The quality of the offerings is sincerely to be deplored. I had occasion, quite recently, to make analysis of some twenty samples of fire-brick from various firms in this country and abroad and regret to say, that of the lot, only half a dozen contained less than 5 per cent of iron. A prominent manufacturer has recently made the statement that he was forced to cater to the desires of his customers who refused to pay the price necessary to make a good brick. I show below a few analyses of representative fire-brick:

		% Silica	% Iron	% Alumina
1	Foreign	54.5	10.5	35.0
2	"	57.9	4.5	37.6
3	American	59.2	2.3	38.5
4	"	68.3	2.5	29.2
5	"	59.0	3.7	36.8
6	"	58.3	9.0	27.9
7	"	73.2	3.6	22.6
8	"	78.2	3.3	17.7
9	"	52.8	5.9	41.3
10	"	60.4	5.5	32.0
11	"	69.8	3.8	26.4
12	"	61.7	7.7	30.6
13	"	59.4	8.3	26.4

Lime for purifying material should be analyzed for purity and purchased on the basis of cost per barrel of pure calcium oxide. It may be found that for the manufacture of purifying materials, some of the dark colored lime containing more impurities may be cheaper for the purpose on the basis of calcium oxide content and yet satisfactory.

The same may be said of copperas.

Although an elaborate equipment is needed for the valuation of lubricating oils, yet a few simple tests in regard to viscosity may enable the selection of suitable oil for the different machinery. Should it be desired to go further into the subject, it is possible to install a home-made device for determining the coefficient of friction. It is possible, also, by temperature readings, on one particular bearing in conjunction with a record of the amount used to ascertain the practical efficiency of an oil in actual work.

Experimental Work.

Having taken all the precautions for maintenance of the quality, it now becomes the duty of the oil gas chemist to ascertain, if possible, what conditions of manufacture will produce the required quality with the least possible expenditure of oil.

The question has often arisen in my mind whether it is cheaper to enrich a very lean gas, high in hydrogen, up to the required value by means of very rich hydrocarbons, or whether it is better to maintain a rather more uniform composition. The problem is very complex and by no means depends upon the ultimate analysis of the gas, i. e. the percentage of carbon and hydrogen, but rather upon the way in which the same are combined to make up the different hydrocarbons. This results from the fact that it is quite possible to combine the same amounts by weight of carbon and hydrogen into hydrocarbons and combinations of hydrocarbons having widely different illuminating and calorific values. In other words, the several possible combinations of the same amount of carbon and hydrogen require different expenditures of energy. It follows that the combustion of these bodies will likewise liberate different amounts of energy.

Practically, of course, it is impossible in operating to produce any particular hydrocarbon to the exclusion of others. However, these various members of the same family are generally produced under much the same conditions.

We may, therefore, study operating conditions with a view to producing the maximum of that particular family which gives the highest operating efficiency.

It is well to bear in mind that while we are able to store up varying amounts of energy into the hydrocarbons, that the same must of necessity be either furnished from the energy of the oil used for heating the

sets or from the waste energy of the by-products.

Concerning the better utilization of the heating oil, the problem depends upon the following factors:

1. Quality of checkers.
2. Spacing and arrangement of checkers.
3. Investment and labor charges due to capacity of set.

Concerning the quality of fire-brick, it cannot be too much emphasized that the best is by far the cheapest from any standpoint. It is to be regretted that the best quality of fire-brick is not more generally used. A fire-brick must have sufficient conductivity and heat capacity to efficiently store up heat, and the ingredients and workmanship must enable it to stand up to the work. All generator control is absolutely useless without this prerequisite.

Assuming, therefore, that the brick are the best obtainable for oil gas, they must now be arranged in such a manner as to offer the greatest possible surface to the heat of the blast and the proper breaking up of the crude oil. This can only be obtained by complete baffling or staggering. The practice, obtaining in some localities, of laying the checkers in straight flues cannot be too strongly condemned. It is simply a confession that the amount of making oil per run has not been correctly gauged. The spacing of the checkers must be likewise set according to the quality and amount of the making oil. With heavier oils it may be necessary to carry the generator checkers much farther apart in order to prevent excessive fouling. The amount of making oil will depend upon the amount of blast pressue available for heating it and the temperature which it is desirable to carry. The more making oil used per run the wider must be the spacing of the checkers and the lower the thermal efficiency of the set. This brings us to a consideration of the investment and labor charges due to the capacity of the set. It is undeniable that in contemplating many changes that would tend toward greater operating efficiency, we are confronted with the capital investment. While very slight reductions in cost of operation will pay several times over for the increased labor and capital charges, it is doubtless true that the capital may not always be available. Changes can therefore only be made up to the excess generating capacity.

With the heating oil used to the best advantage we have a definite amount of heat stored up in the checkers, to be utilized in making the maximum amount of gas of a certain quality.

We will now discuss this point from the standpoint of the two shell machine, composed of generator or primary shell and secondary or combined carburetter and superheater. It is now desired to divide the total amount of oil between the two shells with a view to

a. Producing the most gas of the desired quality from the least amount of oil.

b. Maintain the checkers in the best shape.

It is only by diminishing the calorific value of the by-products that we can increase that of the gas produced. Now in as much as the lampblack made is fully utilized in the production of steam or in the manufacture of briquettes, we do not care, therefore, to draw upon that source; moreover, carbon tends also to increase the specific gravity of the gas and thereby to lessen the capacity of the mains. It is the carbon in combination with hydrogen, passing off as tar or pitch that we wish to retain. In so doing we would eliminate the greatest nuisance incidental to oil gas manufacture. We must therefore operate to eliminate tar and pitch. Tar and pitch are produced at the latter part of the runs, lampblack at the beginning. To eliminate the two first we must stop the run with the appearance of tar, while in order to produce the required quality of gas, we must do away with the high heats of the initial part of the run.

We thus arrive at the old water gas idea of short runs and blows, to which, of course, there is an economical limit due to the time lost during changes and purging set.

By avoiding on the one hand the high heats which tend to melt the checkers and on the other hand the low heats that cause an accumulation of carbon in the spaces, we tend to increase the life of the checker work.

By analyses and compilation of data the chemist should be able to advise changes in operating methods which should always be carried out singly in order to be sure of the cause of any observed result.

It is well for the chemist to carefully study the efficiencies and losses of different parts of the manufacture, both thermal and mechanical, as this forms the basis for all improvements. For this purpose careful measurements should be made of all materials and energy entering and leaving various portions of the works.

There is no better example of such work than that remarkable paper "The Practical Efficiency of a Water Gas Set," by W. E. McKay.

Appliance Work and Illumination Photometry.

The chemist is often the only scientific man on the manager's staff and may therefore be expected to render assistance whenever trained observation and a good knowledge of scientific principles are likely to be of use in solving any particular problem. He may be expected to gauge the capacity of appliances or regulate the burners on same or in other ways introduce scientific ideas into other departments than the works. In this connection he may be called upon to pass upon the respective merits of various brands of mantles or aid in illumination work, both of which he is qualified to handle in connection with bar photometry work.

In concluding this paper, I wish to say that I have purposely omitted many details which are readily available in the text books, and wish to especially call attention to the excellent instructions that have been brought out by the American Gas Institute for the Standardization of Photometry and Calorimetry.

A new water-power agreement has been approved by the Secretary of Agriculture. Temporary two-year permits will be issued to persons wishing to develop water-power within the national forests, thus giving opportunity to make surveys and collect data upon which the final agreement will be based. This contemplates the full development of each water-power site, with the privilege of fifty years' use.

THE PROBLEM OF TECHNICAL EDUCATION, WITH SPECIAL REFERENCE TO CONDITIONS ON THE PACIFIC COAST.[1]

BY S. B. CHARTERS, JR., AND W. A. HILLEBRAND.

Of recent years dissatisfaction has been expressed in many quarters with the results of technical, or, to be more specific, electro-technical education. However criticisms of this nature are not directed alone at the graduates and faculties in electrical engineering, but are only a part of a wider discontent with existing conditions, such as Presidents Wilson and Lowell voiced somewhat over a year ago. The chemists, for instance, are concerned with the same problem that has agitated the proceedings of our own Institute and one of the author's colleagues in the department of law expressed his opinion that one year should suffice to accomplish the work for which the average student now requires four.

Nor is dissatisfaction with the educational system of the day anything new. About two hundred and sixty years ago John Milton in a letter to Samuel Hartlib outlined a scheme of instruction and training which, between the ages of twelve and twenty-one, would give the youth of his day intimate knowledge of Greek and Latin, French, Italian, Hebrew, and the Chaldee dialect, mathematics and natural philosophy in all its branches, including both pure and applied science, the principles of economics, and, in fact everything that would constitute the vehicle of cultural training in his day or this. In addition thereto, his graduate would emerge a trained soldier, experienced in the use of his weapon, in military tactics and hygiene and was also to possess familiarity with the affairs of business and commerce acquired by actual contact with the world.

From Milton to Steinmetz is a far cry, but to the criticism of each there is a similarity in tone that is startling.

Since criticism of educational methods is neither new nor confined to one branch alone, the conclusion is inevitable that the cause does not rest solely with the college but lies deep in the organic life of our nation.

To be productive, criticism of a scheme or system must also take into account the purpose which that system is trying to accomplish, the material with which it works and the conditions under which that work is done, of which, in all that has been written of late, surprisingly little has been said. With these factors that constitute the problem of education of any kind, this paper proposes chiefly to deal.

The purpose of education is to fit the student for life, and to this end, we of the universities maintain that our best efforts are devoted. In reply we are told that instead of being fitted for his vocation, the average graduate upon entering industrial life, finds the change so great that he requires about two years in which to discipline himself to the new environment and acquire a new point of view; that college men are generally narrow, one sided, often clannish and that of the fifty per cent or less of technical graduates who eventually become engineers, but few are able to demand compensation commensurate with their services.

Because these short comings usually accompany a university diploma the burden of them all is placed upon the college, simply because that institution had the student last, unmindful of the fact that only four of his twenty-three years were spent within its doors, and that although these years of residence have placed an indelible stamp upon him, he is much more a product of the years that went before.

The truth of these criticisms is readily admitted by university faculties, who have responded by adding from one to two years to the college course, or by instituting some form of co-operation between college and factory, such as that now established at the University of Cincinnati. The general idea back of the six-year course seems to have been voiced by President Van Hise of Wisconsin, who says that in dignity engineering will then be placed on a par with law and medicine, as if the conditions under which the lawyer, doctor and engineer each does his work were the same, so that a rule applicable to one will also fit the other. The added year or two in which a smattering of cultural training is afforded, is to greatly increase the potentialities of the present engineering graduate—but will it?

Before continuing on this topic let us turn to a consideration of the limitations inherent in formal education under present day conditions, as it exists after centuries of evolution and experience.

In school or college the student pursues at one time several different subjects, between which there is little or no correlation, to each of which he devotes a portion of his attention at different times of the day, and in which the required work demands so much of his time and effort that little is left for spontaneous or continued and concentrated thought.

Owing to the numbers of students who crowd to our engineering schools, the relative proportion of instructors to pupils has so rapidly diminished that the lecture system has largely supplanted individual instruction. A flagrant instance will be cited by way of example. One of the authors finds it difficult to teach a single class of fifteen men in a subject which he himself took at an Eastern institution where the instructor had four classes a day of from thirty to fifty men each.

Abroad this method has been developed to meet the needs of maturer and more serious students in institutions established upon fundamentally different lines, where the amount of work and attention that an individual chooses to devote is left largely to his own inclination. He may take what is offered or not, as he pleases. In America under this same system, but where the student has to satisfy a minimum requirement in order to remain in college, a considerable number who are really not fit for their profession, succeed in obtaining a degree.

The difficulty even in a small class, of learning by set and infrequent examinations what the student really knows is illustrated by the following example, which is offered because we believe it to be thoroughly typical.

Less than a year ago one of our Seniors confessed that he did not realize that when the power factor in a circuit is less than unity, for a part of the time the current is flowing in a direction opposite to that of the

[1]Paper presented before San Francisco Section, A. I. E. E., Oct. 28, 1910.

source electromotive force. We had been instructing him in the principles of alternating currents for nearly a year, during which time this very point had frequently been dwelt upon. He was a man of average ability, of more than average industry, able to pass successfully his examinations, but only during an interview of three-quarters of an hour was his ignorance of so fundamental a fact discovered.

Owing to the relatively limited resources of our colleges, such instruction as brings the teacher into close and intimate contact with the student is handled for the most part by young and generally inexperienced men.

Furthermore, in spite of Mr. Taylor's objection,* the college method is inherently a sixty or seventy per cent method, making it possible for a student to oversleep or deliberately cut two or three times a semester without serious consequences. To a more rigorous discipline than that which exists in most American colleges, the spirit of this country, an illustrated in the attitude of the students, their parents and friends will not submit. College training in itself cannot give the discipline demanded by the conditions of industrial life.

In accounting for the results turned out by American colleges, no analysis is complete which does not consider the social environment of our students. Consider a group of from fifteen hundred to three thousand typical young Americans of about the same age, gathered into one community, nominally under the guidance of their teachers, but in so far as their real, spontaneous interests and activities are concerned, left entirely to their own impulses. At Stanford this condition is perhaps as acute as at any other place in the country, because the student body is so compact and far removed from any large center where the students as individuals would have other things to demand their attention and interest. In passing it may be well to remark that while the isolation of such a community is for many reasons desirable, such isolation also brings with it decided disadvantages.

A committee of Yale Alumni appointed to consider "Ways in Which the Intellectual Ambition of Undergraduates Can Be Stimulated," suggested** among other things, that it might be well to let down the entrance requirements, so that the preparatory and high school could allow the student more time in which to exercise his own tastes in the matter of study and thus cultivate an "intellectual interest in what has happened and in what is going on in the world." This suggestion overlooks one vital fact, namely that, even in the professional courses the spontaneous and vital interest of most young men and women does not lie along the lines of the curriculum, so that to compete with the otherwise all absorbing athletic and social interest we of the faculties have expanded our required work until only a minimum of time is allowed for indulgence in "outside" activities.

Also, as previously stated, little time is allowed even to those naturally so inclined for independent effort and study. In most American universities with the number of students to be handled, it is physically impossible for the faculties to give and properly supervise work of the problem nature which makes a real demand upon the intellectual powers of the student. The result is, that the principal emphasis is placed upon memory and manual labor. The wholesale problem and competition have forced standardization in education. As frequently happens, a student of inherent ability can, by putting in the time allotted for certain work, and cramming vigorously before examinations, meet the minimum requirements and obtain a degree without having received very much of what his instructors endeavored to impart.

Having considered existing conditions, the question now arises, what should the college be able to do for a man by the time he gets his diploma? What are the specification of the ideal graduate?

First, however, let us consider what the young graduate is and what opinion the world holds of him. R. T. Crane *** has expressed his views in no uncertain and complimentary terms. In an address before the Engineering Students at Stanford Mr. F. V. T. Lee said: "Don't worry about what your compensation will be after you get out. No matter what it is, you will be overpaid." The engineer of a large public service corporation remarked, "We go upon the principle that he does not know anything."

"But why do you use college graduates, rather than younger men direct from high school, or with no education at all?"

"Because they learn more readily than others," was the response.

And there you have it. Few employers want the young man except some of the large manufacturing and operating companies which have developed special organizations for continuing his education to suit their needs. The strenuous years of jumping from one subject to another have given the man who has submitted to their discipline, in addition to some knowledge of mathematics, science and engineering principles, a mental alertness and adaptability, so that he is not afraid to tackle a subject because it is new.

There he stands, a man of some knowledge, considerable adaptability, but with little real intellectual power. Is this all that the technical graduate should be?

The ideal man, to our way of thinking, upon leaving college possesses the following qualification:

1. A foundation knowledge of science, mathematics and engineering principles.

2. Ability to think in a clear and logical manner, to use the tools enumerated in number one.

3. Breadth of view toward his profession and toward his relations with society.

4. Willingness to submit to the discipline of industrial life; knowledge of what it expects of him and of what he may expect in return. He is a man who, with no loss of initiative, and while ever on the lookout for new opportunities, has the patience to abide his time and await results.

To what extent can the college contribute to the production of such a man and what portion of his training lies necessarily without the sphere of college life?

*Why Manufacturers Dislike College Graduates. Electric Journal, September, 1909.

**Report of Alumni Advisory Board to Yale Corporation, on the Stimulation of Intellectual Activity Among Undergraduates, June 20, 1910.

***Valve World, June, 1909.

This is a most vital question and must be clearly understood by both college and student if improvement over existing conditions is to be expected.

But little criticism is directed against the college man on account of what he knows, and it may be assumed that college and preparatory school are doing about as well in this regard as can be expected.

In its ability to train the student in clear and logical thinking the college is lamentably weak and the greatest improvement is to be looked for along this line, but, we thoroughly believe, only by an increased amount of individual instruction by competent and experienced teachers.

Specialized training in any field, engineering not excepted, is narrowing, and to offset this tendency, the course at some institutions has been lengthened to five and six years for the purpose of intruding so-called cultural subjects. As a result of observation and experience the authors believe that the average university with conditions as they exist today, cannot impart or even start a man on the road to culture and breadth of view unless he enters with the desire already implanted in him. Most engineering students do not care for the cultural subjects and many are in college today simply because courses are offered which do not require them. Experience throughout the country with engineers in economics, language and English courses demonstrates that ninety per cent of the men detest the subjects, do as little work in them as possible, and that the time and energy devoted to their instruction is largely wasted and for the most part fails of its purpose.

At Northwestern University, where a five-year course combining both engineering and cultural studies has recently been established, this fact is clearly recognized. The schedule is so arranged that technical and non-technical subjects run parallel throughout the five years, instead of being concentrated in the first year or two, in order that the student will not acquire the impression that history, English, economics and languages are a necessary evil but not a part of his real business. At a college in the Middle West an engineering student explained the neglect of his work in English to his professor as due to the fact that he had been devoting all of his time to his regular university work.

Furthermore, at this institution, even though it is old, as American colleges go, with a large body of alumni and the tradition of culture and humanities back of it, they expect for many years but a small registration, and are prepared to advise any student who demurs at devoting so much of his time to non-engineering subjects, to go elsewhere.

This does very well for that section of the country where so many schools are within easy reach but if Stanford were to adopt such a policy, elsewhere could only mean the University of California. Of the twenty-nine men in our entering class, all but five come from States west of the Rocky Mountains, and out of these five not one was directed to Stanford by reasons that had anything to do with the fact that he proposed to take electrical engineering. Careful inquiry among our Freshmen reveals as nearly as we can determine, that none of them came to Stanford because of the excellence, assumed or otherwise, of our department, but chiefly because the college is near enough to permit their attendance, and, of the various courses offered, Electrical Engineering made the strongest appeal.

The lengthening of our course to five or six years would probably send most of our students to the University of California, throwing an added burden upon that institution without securing the result intended.

To admit that we are turning out as engineers men lacking in breadth of view and catholic spirit, is to confess a weakness, and yet we reject the only remedy that has been offered. But is it fair to throw upon the college the entire burden of instilling the spirit of the humanities into men who will not respond to the effort that is being made in their behalf? Is nothing to be demanded of heredity, environment and previous training? Stanford offers every encouragement to the individual who, of his own volition, elects to spend five or six years in order to get the benefit of a broader training, but we are at present unwilling to prescribe such a routine for all.

The following example of the point of view of a representative group of students is offered because we believe it typical of the attitude of the undergraduates of this or, for that matter, of almost any university in the country. About a year and a half ago the authors became acquainted with a man of mature years, and wide experience, both at home and abroad, who chanced to board at a student club. But because of an odd appearance and his ignorance of who held the Coast record in the two mile or why a man runs to first base after striking a ball, he was an outcast, without friends or sympathy. His right hand neighbor, attracted by his keen intellect and original ideas, drew him into conversation, which had to be abandoned after two days because of the chorus of jeering remarks hurled from all sides. To not one of these men did it occur that he could have ideas or experienses worthy of their interest. Instead they gave full rein to hastily formed prejudice and to the natural tendencies of youth in a manner extremely disappointing to him, coming as he did from a country where university students are the leaders in thought on social, political and economic questions.

Toward a knowledge of the requirements of the industrial world and the disciplinary training which they demand, the university can contribute but little. However, so clearly is the necessity for this realized that some colleges already require of the candidate for a degree that he spend at least a part of his vacations at work in the shop or with the construction gang, under actual industrial conditions. While this is not yet among the requirements for the Stanford degree, it will be as soon as circumstances permit.

It is not to be questioned that a man's career and his conduct in life are largely determined by his point of view. Recollection of our own experience, close observation of the students who pass under us and careful inquiry among our Freshmen as to what they expect within a few years after leaving college, convinces us that the majority of men upon graduating are in their inmost souls, convinced that they are embarked upon a road which, though it has its hardships at the start, will automatically lead them to success and considerable financial return. These men see

nothing but "the top," and that at no very distant future.

To combat this attitude, without attempt to annihilate hope or ambition, is as much, and perhaps more, a part of our duty as the teaching of Ohms law.

In conclusion we make an appeal, as of the utmost importance in improving the status of our technical graduate, for a sharper realization of the limitations of university training by the student, teacher, parent and employer, in the hope that such will lead to a more intelligent effort to supplement its deficiencies and to a more intelligent and willing use of the product of the universities.

THE VOLATILE MATTER OF COAL.

The Volatile Matter of Coal is the title of the first bulletin to be issued by the new Federal Bureau of Mines. The authors, Horace C. Porter and F. K. Ovitz, conducted their investigations at the Pittsburg station while it was under the Technologic Branch of the Geological Survey.

Quoted directly, the authors say: "The investigation has already shown that the volatile content of different coals differs greatly in character. The volatile matter of the younger coals found in the West includes a large proportion of carbon dioxide, carbon monoxide, and water, and a correspondingly small proportion of hydrocarbons and tarry vapors. The older bituminous coals of the Appalachian region yield volatile matter containing large amounts of tarry vapors and hydrocarbons, difficult to burn completely without considerable excess of air and high temperature. Coal of the Western type, moreover, gives up its volatile matter more easily at moderate and low temperatures than that of the other type. The volatile matter produced at medium and low temperatures is rich in higher hydrocarbons of the methane type, such as ethane and propane, which contains a larger portion of carbon than is present in methane.

"These facts help to explain the difficulty of burning Pittsburg coal, for example, without smoke, the low efficiency usually obtained in burning high-volatile Western coals, the advantage of a pre-heated auxiliary air supply introduced over a fuel bed, and the advantage of a furnace and boiler setting adapted to the type of fuel used. They bear directly also on the question of steaming 'capacity' of coal for locomotives, the designing and operation of gas producers for high-volatile fuels, and the operation of coke ovens and gas retorts.

"The results show further that certain bituminous coals of the interior and Rocky Mountain provinces give promise of good yields of by-products of coking, notably ammonia and high candle power gas, comparing favorably in these respects with the high-grade coking coals of the eastern province.

"They show also that inert, non-combustible material is present in the volatile products of different kinds of coal to an extent ranging from 1 to 15 per cent of the coal."

The bulletin will be of interest to fuel engineers, designers and builders of gas producers, gas and coke manufacturers, superintendents of power plants, railway master mechanics and those engaged in the suppression of smoke. The bulletin may be obtained by applying to the Director of the Bureau of Mines,

FAKE ENGINEERING SCHOOLS.

BY ANTONE'S BROTHER.

Brother Antone having been so successful in the electrical engineering line, I concluded to try the business myself, Brother Antone being the guiding spirit, in piloting me to an institution where the mysterious and elusive knowledge was to be obtained.

His own experience with graduates of some of the universities had not been excessively flattering, and he suggested we look up some of the private institutions, obtaining a bunch of catalogues from some of the so-called engineering schools. We started on No. 1, a catalogue of eighty pages, telling in glowing terms of the grand openings for engineers, with a liberal number of pages devoted to the names and addresses of successful students, none of whom to date have answered our inquiries, and we presume they are too busy with their onerous duties in their responsible positions to trouble answering our letters.

After a careful perusal of the catalogue, which was a creditable example of the lithographer's art and would lead you to suppose that it illustrated something, we concluded to visit the establishment, and upon entering the office we were greeted by a very affable young lady, who, upon being informed of our mission, handed out one of the catalogues and advised us that she would ask the professor of electrical engineering to come down and talk with us. Upon greeting us and stating that they taught a complete course in both theory and practice, we were advised that he was the instructor and as it later developed the only instructor. We asked to be shown the electrical department, whereupon he kindly conducted us to the rear of the main building into a little board on end shack which would probably answer for the purpose of a wood shed if the owner limited his fuel supply to a ¼ cord.

Now this department was especially designed for electrical teaching, being fitted up with 5 bell push buttons, and two dry cells connected so as to be operated either in series or parallel, also one ½-kw., d.c. dynamo made in 1870, but needing a little repairs. The dynamo was supposed to be driven by an old gasoline engine, carefully shined up but not in order. A little old dinky switchboard was stuck up on the wall and the instructor informed us that the floor was especially made for tracing the leads from the dynamo as the boards were loose and could be taken up to trace the complicated leads of three wires, which he required each student to take up and place in position before he was permitted to graduate.

Having looked the laboratory over which could be duplicated at any second hand store for $50 at the most, Antone began to ask the professor some practical questions and after the third question, which any ordinary wireman would have to know, he got down off the perch and made a clean breast of his sins and vicissitudes.

The policy of this institution is invariably cash in advance and no money returned under any conditions, or transfer of scholarships. Hundreds of farmers' boys are coming to this institution which advertises far and wide. If you are sending your boy to a school see that they are at least prepared with competent teachers and equipment to teach him what you are paying for.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS

R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Education

The college may well be regarded as a mint which puts its stamp upon the graduate before he enters business life. Just as the gold, silver, nickel and copper from which our money is made must be submitted to many processes in mine, mill and smelter before it is fit for the coiner's hands, so must our youth be prepared through early life for a college training. There are many graduates who, like silver, nickel and copper coins, circulate at far more than their intrinsic worth because of the advantage gained by a college education, while there are some men of pure gold that do not need such a distinguishing mark. There are counterfeits and imperfect coins as well as many foreign ones circulating in the wrong place and consequently not accepted at their face value.

Iron, lead and zinc are far more valuable for industrial purposes than for coinage, just as many men are not fitted for a college education. We could better dispense with copper coins than with copper conductors, and likewise there are some mediocre college graduates who would be more successful if they had learned a trade. All of which goes to show that it is the material in the man and not his education which makes him successful. After it has left the mint, only a numismatist is interested in a coin's antecedents. Commercially it matters little where a man graduated, or when, he is merely expected to make good in whatever he undertakes.

Parents usually consider that the major part of their filial responsibility has been discharged when their children have been given an education. Note the complete passiveness of the subject in the last clause, who does not seek the education but is given it. Herein lies the reason for nine-tenths of the educational failures, and likewise, in its converse, for most of the educational successes. Children go to school to be taught, students should go to college to learn. Then and then only can the college, as the active agent, or predicate if you please, accomplish the desired object of fitting the student for life.

The problem of technical education is now receiving much attention. The ideas of the instructor are well expressed in the paper by Professors Charters and Hillebrand of Stanford University, as published elsewhere in these columns, by which it may be seen that the problem of the educator would be greatly simplified if there was some automatic means of presenting for college training only the right sort of material, properly enthused with sincere desire for knowledge. There is undoubtedly much room for improvement in teaching methods but there is greater need for serious thought among those that are to profit from the teaching. It matters little whether the course is four or six years in length, as the man really begins to learn the true lessons of life after he has left the college. If he be of the right sort he will stop learning only when he ceases work.

PERSONALS.

A. M. Hunt left last Monday for Portland on a ten days' business trip.

R. D. Holabird, president of the Holabird Reynolds Company, is at Seattle.

K. G. Dunn, with Hunt, Mirk & Co., left last Wednesday for Portland and the Pacific Northwest.

G. F. Kirkpatrick, of the General Electric Company's lamp department, has gone to the Los Angeles office.

L. R. Wiley, who is interested in an electric power project at Groveland, Cal., was a San Francisco visitor last week.

Russell Wolden, is now at San Jose looking after the branch store of the California Electrical Construction Company.

S. K. Colby and F. A. Richards of Pierson, Roeding & Co. have returned to San Francisco from an extensive Eastern trip.

C. F. Flinn, of the sales corps of the Allis-Chalmers Company, has returned to the San Francisco office after a trip to Eureka.

Nathaniel A. Carle, consulting engineer, Seattle, Wash., has been transferred to the grade of Member in the American Institute of Electrical Engineers.

James F. Kinder, assistant secretary of the Duplex Metals Company of New York, is at Portland, Ore., where he plans to make his home and to open a branch office for the company.

H. E. Boyrie, formerly Seattle manager for C. C. Moore & Co., and later with the Hallidie Machinery Company, is now sales manager of the Tracy Engineering Company of San Francisco.

W. A. Schoel, formerly with the Portland Railway, Light & Power Company, recently took charge of the steam plant and line department of the Northwestern Corporation at Dallas, Oregon.

John B. Ingersoll, chief electrical engineer of the Spokane and Inland Empire Railroad Company of Spokane, Wash., has been transferred to the grade of Member in the American Institute of Electrical Engineer.

H. C. Goldrick, manager of the Kellogg Switchboard & Supply Company's Pacific Coast branch, recently returned from a Southern California tour. He reports some good inquiries from various points on the Coast.

F. B. Gleason, manager of the San Francisco branch of the Western Electric Company, is visiting the company's offices at Chicago and New York. W. F. Berry, local sales manager for the company, is at the Hawthorn factory.

Cyrus Pierce, San Francisco representative of N. W. Halsey & Co., has returned from New York where he completed arrangements for taking up the $1,500,000 refunding bond issue of the San Joaquin Light & Power Company.

H. J. Tinkham, formerly connected with the plant department of the Pacific Telephone & Telegraph Company at San Francisco, has gone to Spokane, Wash., where he is now superintendent of plant for the Spokane District, vice T. H. Elsom, resigned.

A party of Pacific Telephone & Telegraph officials have returned to San Francisco from Seattle, where they spent a week before the inquisitors of the Railroad Commission of the State of Washington, which has jurisdiction over telephone companies as well as railways. Among the party were P. H. Coolidge, assistant general manager; F. C. Phelps, auditor; C. B. Bush, general commercial superintendent; C. W. Burkett, general superintendent of plant, and B. C. Carroll, general agent.

C. E. Groesbeck, Pacific Coast manager, and F. E. Osthoff, second vice-president of H. M. Byllesby & Co. of Chicago, went to Eureka last week with a party of capitalists. It is understood that negotiations are on foot for acquiring the Humboldt Light & Power Company's system.

E. V. D. Johnson, manager of the Northern California Power Company, had a narrow escape from death in a collision of his automobile with the Shasta Limited near Redding, California, on November 7. The automobile was wrecked and Mr. Johnson was severely though not dangerously injured, his shoulder being broken.

TRADE NOTES.

Chicago Fuse, Wire & Manufacturing Company announces that they are now located permanently in their new six-story building 1014-1022 West Congress St., Chicago, Ill.

The Standard Electric Time Company of Waterbury, Connecticut, with Pacific Coast offices in the Foxcroft Building, San Francisco, have recently equipped five government buildings with their service, including a 200-clock installation at Tacoma.

The United Telephone Company of Woodburn, Ore., has placed an order with the Kellogg Switchboard & Supply Company for a complete central office with a common battery harmonic equipment. This includes a General Electric arc rectifier, harmonic pole-chargers and a wire chief's desk.

T. E. Trask, consulting engineer, Los Angeles, has completed plans and specifications for a municipal water pumping plant for Imperial, California. Mr. Trask recently let a contract for a pumping plant and piping system for irrigating a tract at Orange Cove, Cal. The contract calls for a De la Vergne crude oil engine.

The Westinghouse Electric & Manufacturing Company has sold to the Sacramento Valley Irrigation Company electric motors aggregating 1050 h.p., in three vertical units. Each of the three 350 h.p. 2000 volt induction motors will be direct connected to a turbine pump of special design. The pumps, which will be constructed locally, are to be installed at "the Headgates," near Hamilton, where electrically driven pumps with a capacity of 500 h.p. are already in operation. The new equipment is to be used in connection with the Kuhn projects on one of the largest irrigation and reclamation enterprises in California.

NEW CATALOGUES.

Electric Lighting for Motor Cars and Marine Service is the title of a pamphlet from The Electric Storage Battery Co., portraying their "Hyray" electric lamp.

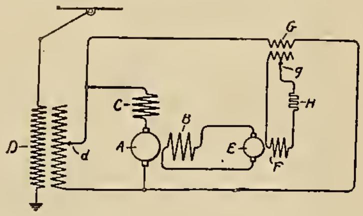
Westinghouse Auxiliary Contactor Equipments are briefly described in Folder 4186 just issued by the Westinghouse Electric & Manufacturing Company.

Bulletin No. 4771, entitled "Hand-Operated Starting Compensators for Alternating Current Motors," has recently been issued by the General Electric Company, superseding previous bulletins on this subject.

Duncan Electric & Manufacturing Company have just issued a new bulletin, No. 11, on Duncan Transformers for Lighting and Power. After briefly sketching the historical development of the transformer it gives illustrated details of the design and construction of Duncan transformers, including the core, coils and insulation, which are followed by an account of the electrical performance. Types listed include those adapted for lighting circuits, power service, subway use, transmission lines, potential or current transformers, tungsten sign lamps, welding and compensators. The section devoted to testing gives valuable instructions and diagrams for the most important transformer tests. The concluding pages are devoted to directions and diagrams for connecting.

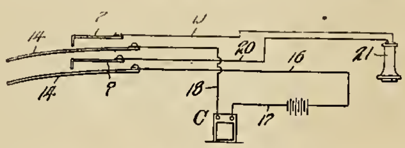
PATENTS

974,224. **Electric Braking.** Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The method of operating an alternating current commutator motor as a generator returning energy to the source for dynamic braking, which consists in connecting the motor armature to the source, separately exciting the motor field



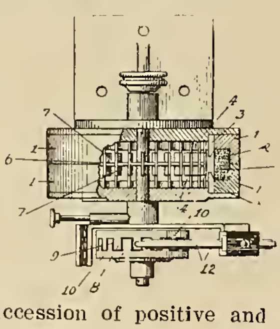
with current approximately in phase with the voltage of the source, varying simultaneously the connections between the motor armature and the source and the strength of the current supplied to the motor field to vary the braking torque, and varying the strength of said current independently to adjust the motor voltage for different speeds.

974,712. **Armature-Testing Device.** Levon H. Seyranian, Monterey, Cal. An armature-testing device comprising a handle composed of sections, said handle having channels, lead-in wires disposed in the channels, fixed contacts connected with certain of the wires, and spring contacts con-



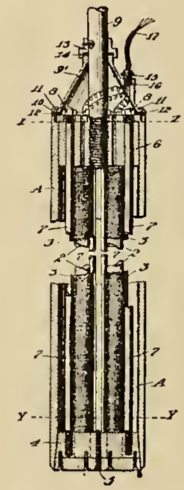
nected with the other wires, said spring contacts being normally separated from and disposed opposite from the fixed contacts respectively and projecting beyond the same to be brought into contact with a pair of commutator bars for testing the windings of an armature.

974,171. **Rectifying Electric Currents.** John J. Montgomery, Santa Clara, Cal. In the art of reorganizing alternating electric current the herein described process of rectification which consists in the following operations: (1) In imparting to the moving element through the agency of a fixed element and the utilization of a derived portion of the current under



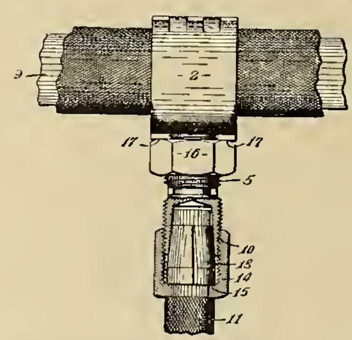
rectification, a succession of positive and negative accelerations, the resultant effect of which is a step-by-step progression of the moving element undulatory in its character, the successive undulations being in response to the successive variations of the electrical forces of the current under rectification, and in synchronism with and coterminous as regards time with, such variations, whether such variations occur in successively equal times or not; and (2) in imparting the said step-by-step progression to an element of a pole changing device having its other elements connected to the circuit carrying the current under rectification, and which said element receiving said step-by-step motion co-operates with the other elements of the pole changing device to successively reverse the order of the terminal connections of the circuit carrying the current under rectification to a utilization circuit.

974,760. **Electric Fishing-Tool.** Harry Eastwood, Fresno, Cal. An electrical fishing-tool comprising a non-magnetic water-tight casing having at its lower end a removable, tapered armature forming a closure, and electro-magnetic means



housed in the casing and connected with said armature, said armature made in sections insulated from each other and adapted to be separately energized.

974,462. **Electrical Coupling.** Carl H. Bissell, Syracuse, N. Y., assignor to Crouse-Hinds Company, Syracuse, N. Y. In an electrical coupling, a band member comprising two sections pivotally connected to each other at corresponding ends and provided at their opposite ends with opposing externally threaded projections, a main member having a shank pro-



vided with an engaging face at one end for co-operating with the band member, the shank having a substantially cylindrical portion, and the inner faces of said projections being shaped to conform to the periphery of the cylindrical portion of the shank, and a nut for engaging the externally threaded projections and the shank, substantially as and for the purpose described.

INDUSTRIAL

A NEW ELECTRIC RANGE.

The kitchen equipped with electric heating devices is a "model kitcheu," free from smoke, ashes, gas odors, fire hazard from naked flames, prostrating heat in summer time, delays waiting for the kindled fire to burn, nuisance of matches, etc. The bustling housewife of the present day gladly adopts devices which add to her convenience or enable her to prepare food in a more sanitary manner. Electric heating devices mark a great stride forward in both respects and are being widely adopted.

The domestic electric range recently perfected by the General Electric Company is a decided advance in the right dirction. It is patterned after the ordinary gas range and cooking can be done with it as quickly as with gas or coal, due to the fact that the heating elements are made of calorite, a wonderful new alloy discovered by the same manufacturer after years of scientific investigation in its extensive research laboratories.

There are three disk stoves on the top of the range designed to be used in the same manner as the burners of a gas range. A turn of the snap switch turns on the heat instantly at full intensity, while another turn cuts it off, and so permits the elimination of any expense for current when the stove is not actually in use, without incurring a delay in getting it into operation again. The two larger stoves are provided with a switch which admits of a three-heat regulation, thus making it possible to get a low, moderate or high heat, as conditions may require. The three stoves permit cooking one, two or three things at once.

The combination oven and broiler is commodious, being 18 inches by 18 inches by 12 inches, and ample for the needs of a large family, and is provided with heating units at both top and bottom. By removing the ceiling plate of the oven, the top heating element of the latter is exposed and may be used as an overhead radiant broiler, or for the purpose of producing a pronounced browning of pies, biscuits, roasts, etc. The ceiling plate can be used as a shelf to support the broiling pan at the proper distance below the heating element.

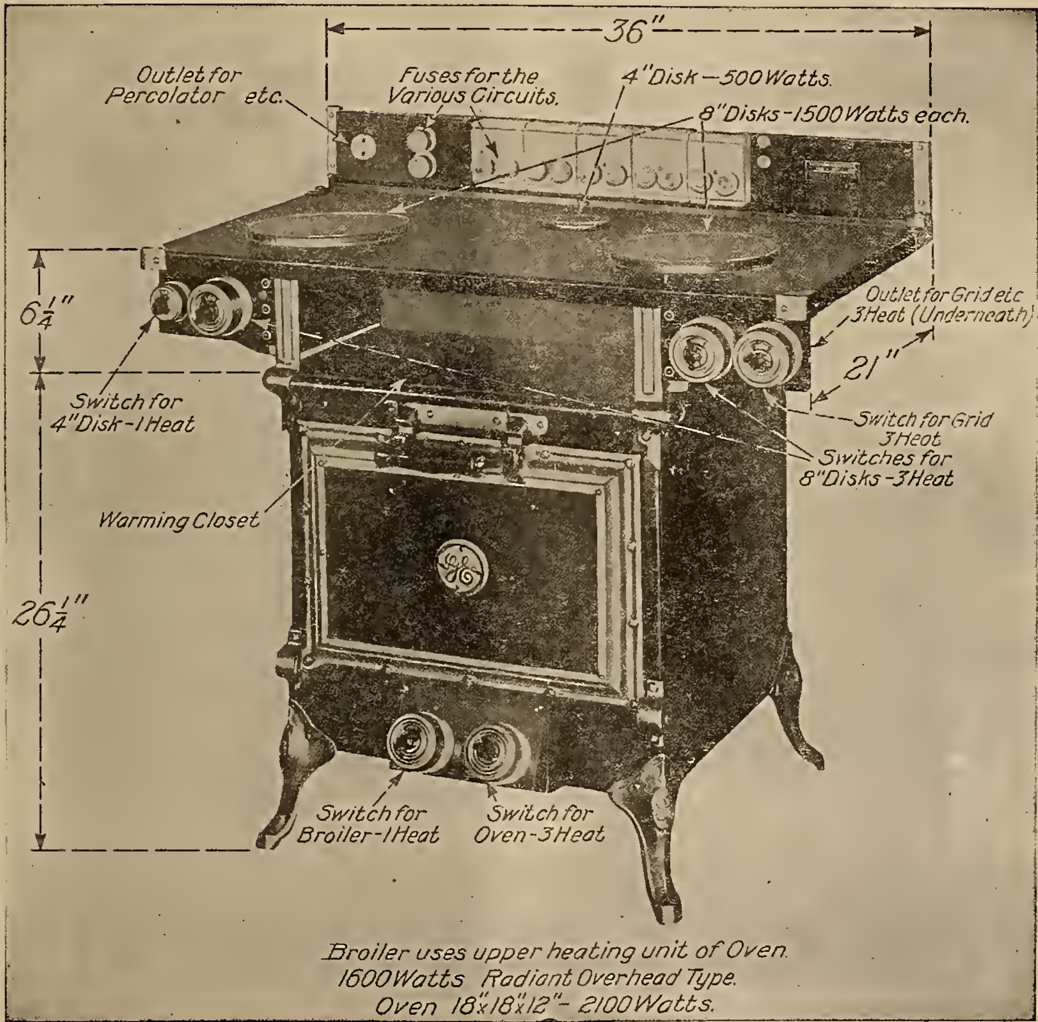


Fig. 1. General Electric Company's New Domestic Range, Type D-22, Showing Dimensions.

The slide supports on the side of the oven permit vertical adjustment of the broiling pan and oven shelves, and also the use of several shelves at once. The broiling pan (which is furnished with the range) is also suitable for use as a roasting pan. Printed instructions accompany each range, and tell what "heat" to use and how long to leave it on to bake or roast the various kinds of meat, bread, cake, pie, etc. The stoves, broiler and oven all have independent controlling switches. It is not necessary to use a thermometer with this oven, as the temperature attained at the various positions of the switch for the intervals of time stated in the instructions accompanying the range, will be best suited for each individual case.

The space between the stove top and the oven is heated

indirectly from the oven, broiler and stoves, and so makes a convenient plate and food-warming closet.

To increase the usefulness of the range two additional outlets are provided for individual electrically heated devices; one being an outlet for a percolator, etc., of one heat and not over 600 watts, the other an outlet for a grid or other three-heat electric device, a three-heat switch being mounted on the range for its control.

The equipment of the range is as follows:

2 8-inch disc stoves, 375-1500 watts; 3-heat switch.
1 4-inch disc stove, 500 watts, 1-heat switch.
1 broiler, 1600 watts; 1-heat switch.
1 oven, 575-1150-2100 watts; 3-heat switch.
1 warming closet (directly heated).

The circuits to each part of the range are separately fused by a double-pole fuse block, while a main fuse of 60 amp. capacity protects the entire range. The wiring is arranged for either two or three wire connection.

The range is of sheet metal construction throughout, made in a workmanlike manner and finished with nickel trimmings. The oven door is of the spring drop style and is provided with a substantial and effective latch.

FLAMING ARC LAMPS FOR LIGHTING LARGE AREAS.

The development of the flaming arc lamp and its general commercial application to lighting large areas has brought about an important advance in the efficient lighting of machine shops, railroad yards, foundries, warehouses, wharves and convention halls. This form of lamp owes its popularity for this class of service to its great brilliancy, its penetrating power, its low operating expense and its pleasing effect upon the eyes.

It used to be the common practice to hang up almost any kind of a lamp in a haphazard way to light a mill, but those days of inefficient lighting are past, and to-day the mill superintendent recognizes the fact that a well-lighted shop means more and better work and contented workmen.

In foundries, steel mills and machine shops where the ceilings are high, lamps of great penetrating power must be used, because at the present time traveling cranes are used in almost every shop of any size, and in many cases it becomes necessary to hang the lamps above these cranes.

The large machine shops and foundries are generally built with two or three bays, a popular arrangement being one central bay, in which the heavy work is handled, and one or more side bays usually built with galleries in which the lighter and detail work is carried on. Often these side bays also have traveling cranes, and in that case the lamps are hung around the sides of the bay. The upper gallery and main bay, however, are generally illuminated by hanging flaming arc lamps above the cranes. Before the introduction of the flaming are lamp no solution could be found for successfully lighting these high-ceilinged interiors where dust, smoke and vapor were always present, but in the flaming arc we find a lamp suitable for such service.

For some time the Crucible Steel Company of America, at Harrison, N. J., had difficulty in finding a satisfactory means of illuminating its gun and projectile shop. In this shop, which works day and night, turning out guns and projectiles for the United States Government, good light is imperative. The guns and projectiles made for the Government are built under very rigid specifications, and each shell and gun undergoes very close inspection during the process of construction. It is apparent that without good light much of the work would fail to pass the inspection and thus be rejected.

This shop was formerly lighted by carbon arcs, but these proved unsatisfactory, and incandescent lamps were added. These individual incandescent lamps were hung near the various lathes, planers and other machines, and it was thought that this would solve their lighting problem. This combination failed, however, for the men on the night shift were continually having trouble with their eyes. As a last resort, flaming arcs were tried, and after a thorough test seven Western Electric "Hawthorn" flaming arcs were installed in the main gun shop and three in the adjoining shop. These lamps were run two in series on a 110-volt circuit, and although the voltage is very unsteady, due to the fact that two or three 40 or 50 horsepower induction motors are often started or reversed simultaneously, the lamps are operating very satisfactorily.

It is interesting to note the increased production resulting from the installation of these lamps. After the flaming arc lamps had been installed for some time it was noted that the increase in the amount of work turned out by the night shift was a little over 10 per cent. In order to determine whether or not this was due wholly to the introduction of the flaming arcs, the lamps were taken out for a time and the night work carried on with the old lighting system. It was then found that the amount of work dropped off over 10 per cent, and that when the work was again carried on under the flaming arc lamps the men were able to produce 10 per cent more work.

Hawthorn Flaming Arc Lamps at the Gun Shop at the Crucible Steel Company of America's Harrison, N. J., Plant.

This increase in production is due not only to the amount of light, but to the quality. The golden yellow rays of the flaming arc lamp are stimulating in character and very easy on the eyes, and since these lamps have been installed night men have found it possible to turn out a greater amount of work with less effort than was possible with the old carbon lamps.

There is no doubt that the illuminating engineer has an instrument in the "Hawthorn" flaming arc lamp which will greatly assist him in giving his client a satisfactory means of lighting large areas.

The problem of lighting foundries has heretofore been a difficult one because of structural conditions, overhead cranes and the presence of smoke and dust. One or two flaming arcs hung above the cranes will satisfactorily light a foundry 50 by 100 feet.

As to the economy of such an installation, the flaming arc stands out prominently as the cheapest illuminant, when we consider that a flaming arc lamp gives 3000 candlepower at 550 watts, the operating cost is low, and so few units are required that the installation and maintenance cost is very small.

NEWS NOTES

FINANCIAL.

ONTARIO, CAL.—The water bonds election was voted here on October 31st; bonds amounting to $175,000.

OCEANSIDE, CAL.—Sealed bids will be received by the Board of Trustees of the city until 4 p. m. November 23 for the purchase of $20,000 water works bonds.

ASHLAND, ORE.—Bonds for the completion of the electric lighting and power system have been sold to J. N. Wright & Co. of Denver, and the plant will be rushed to completion.

PASCO, WASH.—The proposition of issuing $39,000 for the purchase by the city of water works, plant, system, right-of-way land lots and the franchise now operated by the Pacific Light & Power Co. Election to be held December 6th.

LOS ANGELES, CAL.—In order that work on the aqueduct may be accelerated and no time lost for want of funds, negotiations have been entered into between the city officials and a New York bond syndicate which may result in the syndicate's purchasing $1,000,000 of aqueduct bonds at once and in advance of its February option.

SACRAMENTO, CAL.—A special municipal election will be held in the city of Sacramento, Cal., on November 16th, 1910, at which time will be submitted the question of issuing and selling bonds in the amount of $666,000 for the purpose of acquiring and constructing a filtration plant, reservoirs, pumps and other appliances to be used with and in connection with its waterworks for the purpose of storing filtering, purifying, conducting and distributing water for the use of the city.

TRANSMISSION.

CHEHALIS, WASH.—This place has decided to install all wires and pipes for lighting and heating purposes underground in the future.

GUIER, WASH.—D. E. Witt of the Trout Lake Valley is preparing for the installation of an electric plant to light and operate machinery on his ranch.

HILLSBORO, ORE.—The county court has granted the franchise of the Independent Electric Company to set poles on the county road from Oak Park to Beaverton.

SPOKANE, WASH.—This city has started negotiations to obtain control of all the power sites on Priest river from its source in Priest lake to its conjunction with the Pend d'Oreille river.

ALAMOGORDO, N. M.—Preliminary construction work for the hydro-electric power plant in Box canyon is now under way, with T. M. Morton in charge. M. H. Fisher is also interested in the project.

ELTOPIA, WASH.—This place will be soon supplied with electricity. The Yakima Light & Power Company contemplates running a high voltage wire from Pasco to Lind, Wash., serving intermediate points.

LEWISTON, IDAHO.—Steps have been taken by the Lewiston-Clarkston Improvement Company, of which E. H. Libby is president, for the enlargement of the steam auxiliary power plant located on the Snake river.

OROVILLE, CAL.—O. M. Enslow, a Berkeley engineer, has filed upon 40,000 miner's inches of water in French Creek. The appropriation states that the water is to be used for the purposes of power manufacturing. A dam 100 feet high and 600 feet long at its crest is to be built and the water carried by flume to the proposed plant.

CENTRALIA WASH.—Bids will be received up to November 15 by the city clerk for delivering machinery for a 1000 kilowatt turbo-generator lighting plant, said machinery to be delivered f. o. b. this place. Specifications at the office of city electrician, C. A. Harmony.

SAN FRANCISCO, CAL.—City Attorney Long has informed the Supervisors that no corporation has a legal right to install steam pipes in public streets, for the purpose of furnishing heat to consumers, without first having obtained a franchise from the Supervisors.

TACOMA, WASH.—The Seattle-Tacoma Power Company through Attorney N. W. Brockett, representing Manager Morton Ramsdell, petitioned the Board of County Commissioners for a franchise to set its poles on the Indian Ferry-Stuck Valley road. The hearing of the application for the franchise has been fixed for November 25.

CHICO, CAL.—Charles Leege of San Francisco, president of the Central Traction Co.; T. Tognazzini, vice-president of the Swiss-American Bank of San Francisco and of the traction company, and A. B. Parker, a San Francisco capitalist, have been here to inspect the plant of the Sacramento Valley Power Company in which they are interested. Plans for the enlargement and extension of the plant are being considered.

ANDERSON, CAL.—Five carloads of machinery consigned to the Northern California Power Company have arrived here. All this will be hauled by traction engines to the company's new power house under construction at Coleman, on Battle Creek, five miles upstream from Ball's Ferry. Ten miles of ditch are under construction. One mile of siphon pipe will be laid. The pipe will be seven feet in diameter. The total generating capacity of the Coleman plant, which will be in operation by June 1 next year, will be 16,000 h.p., making the total output of the power company 47,000 h.p. The company has 258 miles of 22,000 volt lines and 126 miles of 66,000 volt lines. There are 34 sub-stations located at these places: Redding, Iron Mountain, Horsetown, Germantown, Keswick, Kennett, Copper City, Winthrop, Gladstone Mine, Brunswick Mine, Millville Magalia Mine, Lappin Mine, Balaklala Mine, Mammoth Mine, Manton, Shasta, Old Diggings, Coram, Baid, Proberta, Heroult, Anderson, Cottonwood, Red Bluff, Tehama, Los Molinos, Vina, Chico, Orland, Corning, Willow and Hamilton.

TRANSPORTATION.

MISSOULA, MONT.—The local electric railway will start in the spring on the extension of the line.

MEADERVILLE, MONT.—Mr. Wharton, manager of the electric street railway here, states that the line will be extended about half a mile.

TUCSON, ARIZ.—Within a few weeks a street car line, costing approximately $12,000, will be built out east on speedway by the Tucson Electric Railway Company.

LEWISTON, IDAHO.—H. Galvani, engineer in charge of right-of-way for the Pacific Power & Light Company, and the Walla Walla Valley Railway Company is here on business connected with the establishment of the proposed Lewiston to Asotin interurban railway.

SACRAMENTO, CAL.—Ballasting has been completed on this company's line to Stockton. This has permitted the company to cut down the running time between Sacramento and her sister city in San Joaquin 20 minutes. Beginning November 1 six trains a day will be run. They will leave Eighth

and J streets as follows: 7:10 a. m., 10 a. m., 12 m., 2:10 p. m., 4:30 and 6:50 p. m.

OAKLAND, CAL.—The Peninsular Railroad Company has begun work on the line, which is to connect Alameda mole with the Sixteenth street station. Franklin street north of Fourteenth is being plowed up in preparation for the laying of tracks to Twentieth street. It is the intention of the company to electricize its present line to the Alameda mole, which is known as the narrow-gauge. It extends from the mole to Fourteenth and Franklin streets. It is from the station at this point that the tracks are to be extended. The company will form a loop track between its Alameda and Oakland moles, a condition which will greatly improve all local traffic.

SAN FRANCISCO, CAL.—A second petition for a receiver and an accounting of the affairs of the San Francisco, Vallejo and Napa Railroad Company has been filed in the U. S. Circuit Court by Arthur W. Fox of Harrogate, England. It is alleged that W. E. Botsford; the president, and J. T. York, vice-president and secretary of the railroad company, have appropriated the proceeds of the sale of the company's bonds to the extent of $968,000. The allegation is made that the defendant is insolvent and that it is necessary that the road be kept in operation to prevent loss, for which a receiver is asked. The complainant holds 952 shares of $100 each and bonds of the par value of $176,000.

ILLUMINATION.

HERMISTON, ORE.—The City Council has granted to B. A. and G. A. Chisholm a franchise to put in an electric plant at this place, to be installed within the next six months.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company has completed plans for the improvement of the lighting and power system, representing an expenditure of $100,000.

CENTRALIA, WASH.—The Council has adopted the plans and specifications of City Electrician Harmony for the installation of a complete lighting plant, the estimated cost of which is between $40,000 and $45,000.

LEWISTON, IDAHO.—Ray M. Hart of this city and other capitalists have formed a company for the manufacture of gas in this city. Its franchise specifies that the construction of the plant must be begun within two years of its acceptance by the city.

LONG BEACH, CAL.—On Tuesday the Long Beach Consolidated Gas Company will take charge of the holdings of the Inner Harbor and Edison Gas Companies and abandon the gas plant on Alamitos avenue. The pumping plant will be maintained there for customers in the eastern part of the town until the installation of a new 500,000 cubic feet gas holder which is to be built on inner harbor. The company will also build a 16-inch main from the new plant to Pine ave.

FRESNO, CAL.—General Manager A. G. Wishon says: "Within the next three weeks it is hoped that the power line of the San Joaquin Light & Power Company may be extended from the big power house to the Kings River rock crushing plant, where the Sharp Fellows Company is constructing one of the largest rock crushing plants in the State, at the end of the Santa Fe extension line now under way. The rock crushing plant will supply the rock to be used in the Santa Fe road bed and for other commercial purposes. It also is believed that well within six months the power line from the Crane Valley plant will have been completed into Bakersfield.

PORTLAND, ORE.—General Manager H. M. Pabst of the Portland Gas & Coke Company announced last week that $500,000 would be expended next year extending gas mains to the suburban residence sections of Portland. Mr. Pabst is now at work on his estimates for 1911 and says that, as at present outlined they contain proposals for the largest amount of work the gas company has ever done in Portland in any one year. The purpose of the company is to supply the entire East Side from the southern extremity of Sellwood to St. Johns, and extending as far east as Rose City Park and Montavilla with all of the intervening territory. On the west side the company expects to furnish gas to the residents to the south as far as Fulton and to much of the newly built up sections in the western portions of the city including the finely populated district beyond Portland Heights extending to Council Crest.

WATERWORKS.

CRESSWELL, ORE.—R. H. Parsons & Co. have secured a lot near the planing mill on which they will erect a tower, and tank to be used by the city water system. The water mains will be extended to the Stratford and Willour Additions at once.

SAN JACINTO, CAL.—Williams & Coffen of Los Angeles, principal owners of the Citizens Water Company which has recently taken over the property of the San Jacinto Valley Water Company, were here last week. The company plans to greatly enlarge and improve the system.

OAKLAND, CAL.—In the annual report of the Peoples Water Company the following is said of the company's new distributing reservoir, located in the hills back of East Oakland: "The central reservoir has just been completed at a total cost exceeding $325,000 (every portion of which is solidly cemented with expansion joints at 12-foot intervals and inclosed by a substantial cement wall three feet in height). It covers 14 acres, has no drainage area and is free from any possibility of surface or underground contamination. Its capacity is 150,000,000 gallons, furnishing an independent gravity reserve supply sufficient for Oakland and Alameda for ten days. Its elevation is 198 feet at the bottom of the wall. The maximum output from artesian sources can now be maintained uniformily through the entire 24 hours.

TELEPHONE AND TELEGRAPH.

VANCOUVER, B. C.—Mr. Geo. B. Halse, manager of the British Columbia Telephone Company, has announced that that company will next spring lay a Pupin coil submarine cable to connect this place with Victoria.

ABERDEEN, WASH.—Negotiations have been about completed for the construction of a telephone line to connect Aberdeen with Westport. This is being backed by local shipping people, and if completed will enable them to have direct communication with the United States life-saving station at the entrance of the harbor and by this means keep in touch with the arrivals and departures.

LOS ANGELES, CAL.—The installation of an efficient and economical fire alarm system and police signal system in the City of Los Angeles, not only to cover its present but its future needs, has been found desirable, and therefore it has been decided to place the complete investigation of this matter in the hands of expert engineers, who will make a complete investigation of the present system, as well as the present requirements, lay out a complete and final plan which may be installed in parts as desired and required by the growth of the city for an ultimate fire alarm system and police signal system, which will fulfill all requirements for not less than twenty years in the future. The members of the committee which has been appointed by Mayor Alexander and approved by the City Council on October 20th are C. L. Cory of San Francisco, E. F. Scattergood of Los Angeles, and Theo. B Comstock of Los Angeles. They will investigate all of the fire alarm systems at present in use to the end that most satisfactory plans may be made for the use of and followed by the City of Los Angeles.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 21 | SAN FRANCISCO, NOVEMBER 19, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXV | SAN FRANCISCO, NOVEMBER 19, 1910. | NUMBER 21

THE INDUCTION MOTOR AND GENERATOR[1]

BY F. G. BAUM.

(Note: This paper practically as it stands was prepared for University students about 1902. On account of the interest in the induction generator and to answer a number of questions, the paper is now published. F. G. B.)

The theory of the induction motor and generator, as we shall see, is practically the theory of the alternating current transformer with open magnetic circuits, that is, a transformer possessing considerable magnetic leakage. We will take up the theory graphically, developing the circle diagram. I believe, with this diagram, one can gain a working theory and see the physical relations much more easily than were the subject treated analytically. After thoroughly understanding the graphical theory one will find no great difficulty in understanding the analytical theory as given by Mr. Steinmetz. The theory as here given is essentially that given by Mr. B. A. Behrend, Mr. Heyland and others, except that the development of the circle diagram as generally given is simplified.

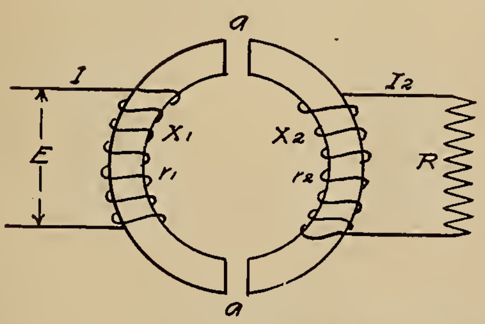

Fig. 1. Transformer With Large Magnetic Leakage.

Let us consider a transformer with air gaps a a (Fig. 1) in the magnetic circuit and therefore having a large magnetizing current and large magnetic leakage. The transformer may be considered as having a ratio of transformation of 1 to 1. This transformer for our purposes may be replaced by the equivalent electrical system shown in Fig. 2. Here we have shunted across the potential E a coil taking the magnetizing current of the transformer, I_0. That is, if the secondary resistance R were opened we would obtain the same primary line conditions, namely, the primary current and power factor would be the same, with the circuit in Fig. 2, as with the transformer in Fig. 1. If, now, R has a given value, in Fig. 2 and Fig. 1, not infinity, the reactance X, (equals $X_1 + X_2$ in Fig 2) would be so adjusted that we again obtain the same primary current at the same power factor for each case.

Practically X_0 would be measured by open circuiting the secondary and taking the ratio of E / I_0, that is $X_0 = E / I_0$, practically.

The current I_0 is nearly wattless, since the only losses are those due to hysteresis and the primary

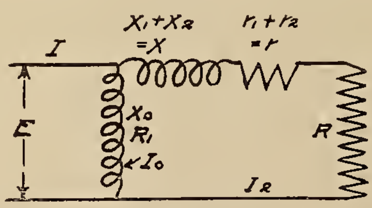

Fig. 2. Electrically Equivalent to Fig. 1.

copper loss. In Fig. 3 we have laid off E = oa, the pressure applied to the transformer and have laid off I_0 = ac, making an angle of θ_0 with E, as determined by the power factor. By projecting the point O on the I_0 line we obtain the e.m.f. triangle o b a, in which ab = $I_0 R_1$. R_1 being the effective resistance; that is $I_0^2 R_1$ equals the total watt loss due to copper and iron when the secondary of the transformer is on open circuit. A more accurate value of X_0 may be obtained by dividing o b by I_0.

The primary open circuit current which we would get if there were no losses may be found by drawing a line at right angles to I_0 at the point c, and obtaining the length a c′ ad being at right angles to E. There is, however, little difference between I_0 and I_{00}

To determine $X = X_1 + X_2$, the equivalent reactance of the transformer, the secondary resistance R is short-circuited and the primary current and power factor of the circuits in Fig. 1 again read. Then we would adjust the reactance X in Fig. 2, until with

[1]A paper presented at the San Francisco Section of the American Institute of Electrical Engineers, Nov. 18, 1910.

$R = o$ we again obtain the same value of the primary current and power factor. In Fig. 4 a c is the open circuit current and $ad_1 = I$, is the primary current in magnitude and direction when $R = o$. The primary power factor gives us the value of θ. The current c d_1 $= I_2$ is not exactly the current in the secondary, but

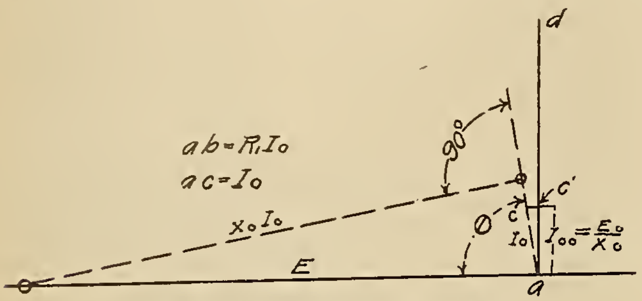

Fig. 3. Secondary Open-circuited.

represents the primary current corresponding. It will, however, be taken to represent the secondary current or the corresponding primary current. If it were not for the internal resistance of primary and secondary. I_2 would increase to the value of $c\,d = E / X$. This length is obtained by drawing a line at right angles to c d, at d, until it intersects the line c d drawn at right angles to E. The equivalent reactance, X, then, is obtained by dividing E by c d in amperes. If the secondary resistance R is varied from a short circuit

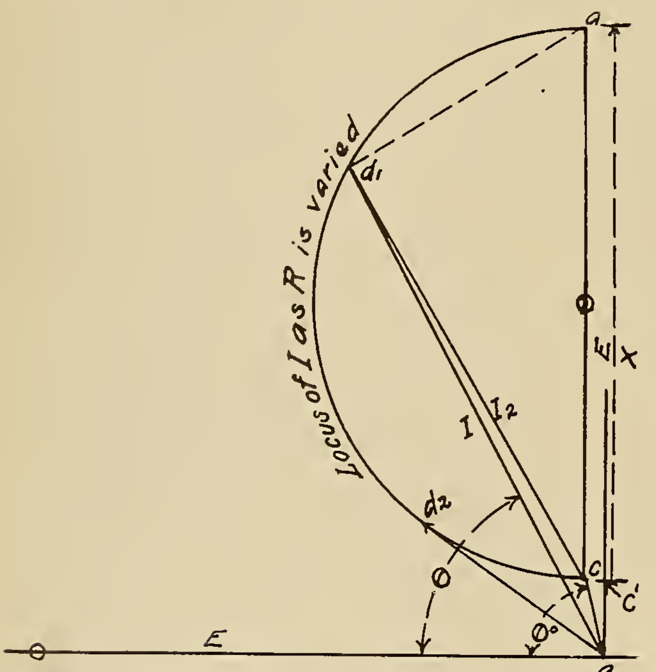

Fig. 4. Showing Locus of Primary Current as R is Varied.

to an open circuit, the locus of I will be the circumference of the circle c $d_2 d_1$. It should be noticed that to entirely determine the locus of I it is only necessary to measure the primary current I_0, the short circuit current I and the power factors θ and θ_0 corresponding to I and I_0. The same will be found true of the induction motor. As E is constant and $X = X_1 + X_2$ is assumed a constant, and we know I_2r and I_2X are at right angles to each other, it follows that I_2 follows the circular arc cd_2 d_1.

In a closed circuit transformer c d is very large compared to a c. Assuming the full load current to be 50 times the open circuit current and the reactance pressure (= X times full load current) of the transformer to be 5 per cent of the full voltage, c d would be 1000 times a c. In an open circuit transformer, however, c d may be only 10 to 50 times a c. Hence we shall see that the main difference between the theory of the closed circuit transformer and the induction motor or generator is due to the difference in the ratio of the short circuit to the open circuit current, and that the diagram of the induction motor is the same as Fig. 4 for the open circuit transformer.

The Induction Motor.

In the induction motor we have a primary and secondary circuit always in inductive relation to each other as in the transformer, the only change being that the secondary generally is in motion, and this fact confuses the relations and reactions. Before applying the above theory of the transformer to the induction motor one should first clearly see that so far as the reaction of the secondary current on the primary is concerned, the secondary could be stationary.

To show this we must consider the rotating field produced by the primary. This field is produced by coils carrying currents differing in phase, the coils being spaced angularly to correspond with the phase displacement in time of the currents in the coil. For a two-phase motor, the winding may be represented

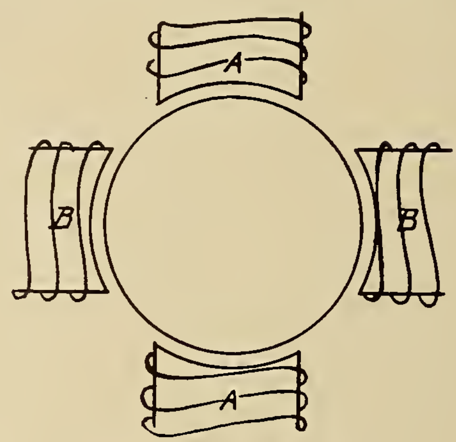

Fig. 5. Two-phase Motor.

diagrammatically as in Fig. 5, coils carrying two-phase currents being placed as shown, would produce near the center a rotating field of constant magnitude, the frequency of rotation being equal (for the case shown) to the periodicity of the alternating current.

Fig. 6 shows a three-phase motor diagrammatically. In order to reduce the speed of the motor, the poles may be increased. Doubling the number of poles reduces the speed to one-half. In practice the coils are not wound on inwardly projecting poles as shown but in slots as in Fig. 7. The air gap is small and is the same all around the circumference of the armature. In America, open slots are generally used. The armature, or rotating part, of the induction motor practically consists of a structure built up of iron lami- The armature, or rotating part, of the induction motor practically consists of a structure built

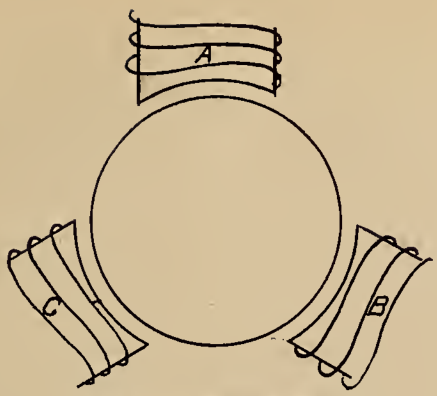

Fig. 6. Three-phase Motor.

up of iron laminations with short circuited bars of copper running from front to back. Although a two or three phase current will not produce an absolutely constant rotating field, yet for practical purposes the field may be considered constant. A rotating field being produced by the primary there will be induced currents in the secondary (the secondary is the rotating armature). When the secondary is at a standstill we have simply a transformer action, the frequency of the secondary

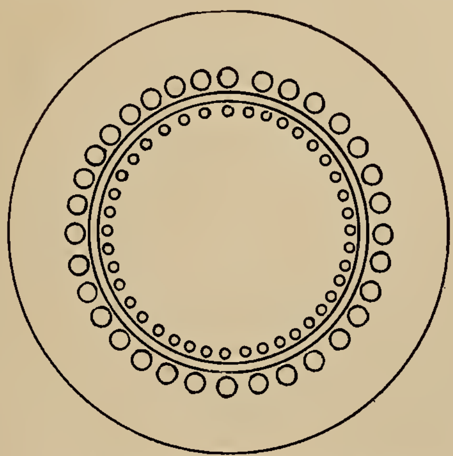

Fig. 7a. Armature and Rotor With Closed Slots. In the United States open slots are generally used.

induced currents being equal to the primary frequency. The primary rotating field will, as may be easily seen, tend to pull the rotating armature after it. Suppose the primary field to rotate at an angular velocity w, and the motor armature to follow at an angular velocity of w_2. The relative motion between the primary field and secondary will then be $w_1 - w_2 = w$, the angular velocity of the "slip," the slip being defined as the ratio $\frac{w_1 - w_2}{w_1} = \frac{w}{w_1} = s$. The e. m. f. and therefore the current in the secondary will have a frequency w, since the rotating field cuts the rotating armature conductors at the angular velocity w. The current induced in the secondary produces a rotating field, the frequency of rotation relatively to the primary being w. But the armature is rotating at an angular velocity w_2 so that the field set up by the secondary is rotating relatively to the primary at a frequency $w_2 + w$. But this is equal to w_1. That is, in its reactive effect on the primary, the secondary current may be considered of the primary frequency w_1.

The frequency of the secondary current being w, the reactive pressure consumed in the secondary decreases in the ratio $w / w_1 = s$, as the "slip" decreases; that is, as the speed of the motor increases the reactive pressure consumed by the secondary decreases. With the armature at standstill, the reactive pressure is $X_2 I_2$; at a "slip" s the reactive pressure would be $sX_2 I_2$, X_2 being the reactance at full frequency, that is, at standstill.

In order to apply the circle diagram to the induction motor, that is to prove that the locus of the

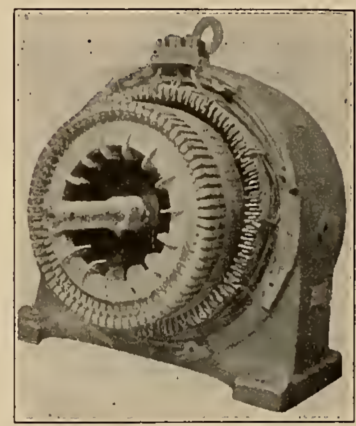

Fig. 7b. Three-Phase Induction Motor, End Bell Removed.

secondary current is a circular arc, it remains to show that a change in speed of the armature is equivalent to a change of resistance R in the secondary of the stationary transformer (Fig. 1).

As in the case of the transformer, we will consider the ratio of transformation between primary and secondary at 1 to 1. Suppose the armature to rotate at an angular velocity w_2, the slip between the rotating field and armature being s. An induced e.m.f. e in the primary then gives an induced e.m.f. se, equals ai (Fig. 8) in the secondary. At standstill s = 1, the primary and secondary induced pressures are practically equal; if w_2 were equal to w_1, s would be zero, and the induced e.m.f. in the secondary would be zero. At any slip s we then have the induced pressure se consumed by the current I_2 flowing over the resistance r_2 and the reactance sX_2. These three pressures se, $I_2 r_2$ and s $I_2 X_2$ form a right angled triangle ahi (Fig. 8).

The current in the armature is

$$I_2 = \frac{s\,e}{\sqrt{r_2^2 + (sX_2)^2}} = \frac{e}{\sqrt{\left(\frac{r_2}{s}\right)^2 + X_2^2}}$$

and we see at once that I_2 is the locus of a circle having $\frac{r_2}{s}$ as a diameter and the current in the armature is the

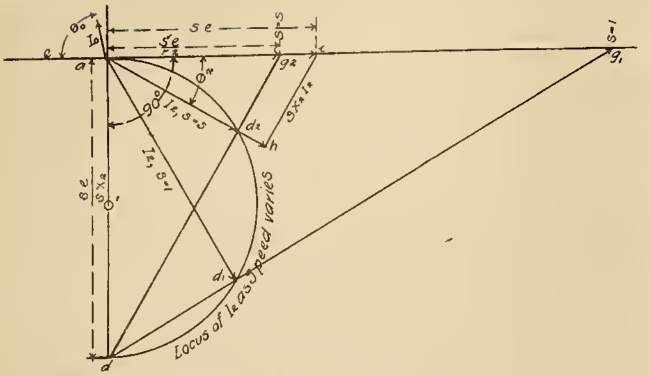

Fig. 8. Current in Armature of Induction Motor.

Note—Fig. 8 shows the current and pressure relations in the secondary and are shown in the lower right-hand quadrant; the corresponding primary relations are drawn in the upper left hand quadrant, Fig. 9.

same as though the armature were held stationary and the resistance changed to $\frac{r2}{s}$ (See Fig. 8).

To represent what takes place in the primary we draw Fig. 9, which is similar to Fig. 4 for the case of

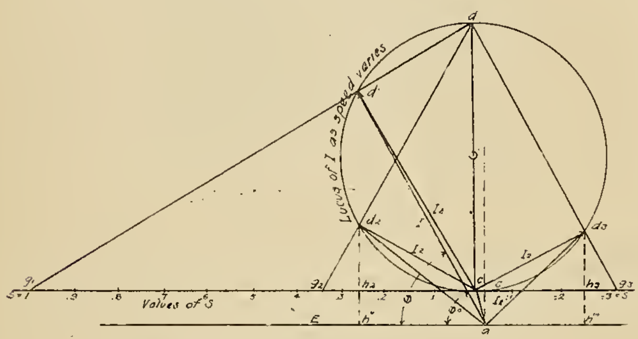

Fig. 9. Circle Diagram, Theoretical.

the transformer. We may substitute E the impressed pressure at the terminals in place of the induced pressure e without serious error. The primary current I is determined by combining I_0 and I_2. It must be remembered that I_2, the true secondary current cannot generally be measured; the I_2, then, in Fig 9 is the primary current corresponding, and is drawn directly opposite to the true direction of the secondary current.

Heretofore the secondary induced pressure was assumed to be fixed in value. This compels the primary impressed pressure to exceed such secondary induced pressure by an amount equal to the pressure lost in the primary impedence. Since the pressure thus lost may be expressed by components in phase and in quadrature with the secondary the same as the secondary induced pressure, the total primary impressed pressure which is the sum of these two pressures may also be so expressed. The circle diagram will, therefore, give the relation between the secondary current and a fixed primary impressed pressure. The two circles, one for the secondary induced pressure fixed and the other for the impressed primary pressure fixed have common locations for their diameters, both terminating at c and differing only slightly in magnitude.

To determine the circle diagram in a practical case we proceed as follows: (1) Run the motor without load and measure I_0 and θ_0 and lay these off to scale (Fig. 10); (2) with the motor at standstill we must determine the starting current ad, and the angle θ. The length ad_1 must be determined with the resistance in the armature in running position. As this would give us too large a current at full e.m.f. applied the impressed e.m.f may be reduced and correction made for full voltage. To determine the diameter of the circle, then, a line d_1 d is drawn at right angles to cd_1 giving cd. The circle may now be drawn. If in Fig. 8 we extend the lines dd_1 and dd_2 until they intersect the line se produced we obtain lengths g_1c and g_2c, which are proportional to the slip of the motor. In Fig. 9, having drawn dd_1 g_1 we may divide the length cg_1 into ten equal parts corresponding to .1, .2, etc., of the slip. The current for any particular value of the slip may be obtained by joining the desired point along cg_1 with the point d. For example when the slip is .33, the armature is cd_2 and the primary current ad_2, Fig. 9.

The power absorbed by the primary is proportional to ah^{111} or c^1h_2, and the power transferred to the secondary is practically (primary copper loss must be subtracted) proportional to ch_2. cc^1 is proportional to the primary input at no load, which includes the mechanical losses, as well as the electrical. cd does not represent the true position of the diameter of the circle, as ac is not the current we would get without the windage and friction of the motor. The value of I_0 will practically not be affected, but θ_0 will be larger which will move c nearer c^1. The point c is, therefore, not the true point for $s = 0$, that is synchronous speed, but $s = O$ is somewhere between c and c^1. The error made, however, in taking c as the point is small and may be corrected by first determining the point c and then separating the electrical and mechanical losses and dividing $c\,c^1$ in proportion, the exact position of the diameter of the circle cd may be found. The length cc^1 should only represent the electrical losses at $s = 0$.

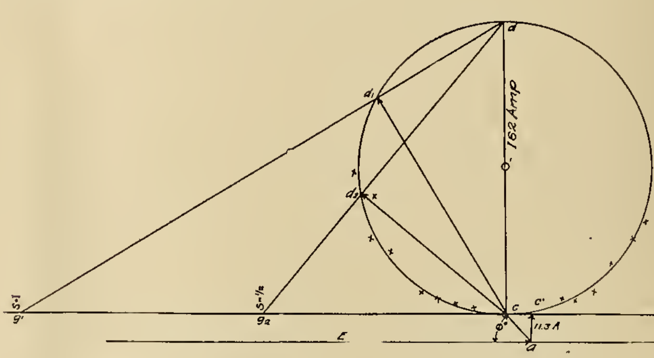

Fig. 10. Diagram for 10-h.p. Induction Motor.

Fig. 10 shows the curve actually obtained from a 10 h.p. two-phase, 200-volt, squirrel cage armature induction motor. ac is 11.3 amperes and cd is 162 amperes. The starting current at full voltage is cd_1.

By a study of this simple diagram, I believe one will get a clearer idea of the induction motor and generator than in any other way. The theory, as pointed out, is not absolutely accurate, but for practical pur-

poses it serves very well. As shown, when developing Fig. 8, we should consider quantities in the secondary, but, as those ordinarily cannot be measured, we must use primary quantities to express what takes place in the secondary.

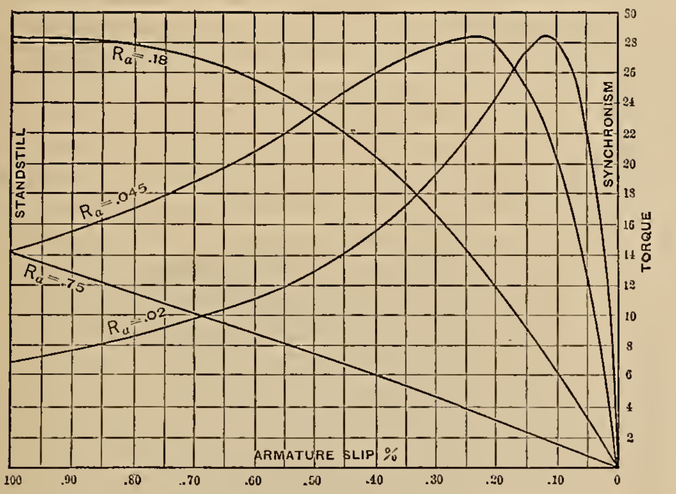

Fig. 11. Showing Dependence of Torque on Slip and Resistance.

The Torque of the Motor.

The secondary input at any slip s is

$$K\ W_2 = e\ I_2 \cos\theta_2;\quad \text{but } \cos\theta_2 = \frac{r_2\ I_2}{s\ e}; \qquad (1a)$$

$$\text{therefore } K\ W_2 = I_2^2\frac{r_2}{s} = \frac{\text{secondary copper loss}}{\text{slip}} \qquad (1b)$$

The secondary output, or the mechanical power developed is equal to back e.m.f. times I_2 times $\cos\theta_2$. That is,

$$\text{Output} = e\ (1-s)\ I_2\cos\theta_2 = I_2^2\ r_2\ \frac{1-s}{s} = I_2^2\ r_2\ \frac{w_2}{w}$$

Expressing this as equal to torque, T times the angular velocity of the motor we get

$$T w_2 = I_2^2\ r_2\ \frac{w_2}{w} \text{ or } T = I_2^2 \qquad (2)$$

But $w = s w_1$;

$$\text{Therefore } T = \frac{I_2^2\ r_2}{s\ w_1} \qquad (3a)$$

Combining with equation (1b) we see that

$$T = \frac{\text{secondary copper loss in watts}}{\text{synchronous speed} \times \text{slip}}$$

$$= \frac{\text{secondary input}}{\text{synchronous speed}} \qquad (3b)$$

The secondary input is sometimes called the Torque in synchronous watts, expressing the power in watts which the motor would develop for the same necessary input if it were running at synchronous speed.

To put the torque in equation (3b) in pounds at one foot radius and the synchronous speed in r.p.m. we must multiply the right-hand member by 33,000 and divide π by 2 times 746. This gives us

$$T \text{ in pounds} = \frac{7.04 \text{ secondary input in watts}}{\text{synchronous speed in r.p.m.}} \text{ or}$$

$$T = \frac{7.04\ (\text{primary input} - \text{no load loss} - I_2^2\ r_1)}{\text{synchronous speed in r.p.m.}}$$

(practically)

From this equation and Fig. 10, we may construct a torque slip curve. We may determine with the circle diagram, as can be easily seen, the efficiency curve, the power factor and any other data desired for practical work. We see from Figs. 9 and 11 (see length ch_2, which is proportional to the secondary input, has a maximum value equal to the radius of the circle cd) that the maximum torque will be practically independent of the secondary resistance. If we increase r_2 we may move the starting current to any point between d_1 and c. In the type of motors using a resistance in the secondary in starting the starting current is made to fall below d_2, Fig. 9. As the motor comes up to speed then the resistance is cut out. The slip of induction motors varies from 1 per cent to 15 per cent according to size, decreasing as the size increases.

From equation (3a) the output in synchronous watts is $T\ w_1 = \frac{I_2^2\ (r_2)}{s} = \frac{\text{secondary copper loss}}{\text{slip}}$.

Now $I_2^2 r_2$ represents the secondary copper loss, and, if we assume the primary copper losses equal to the

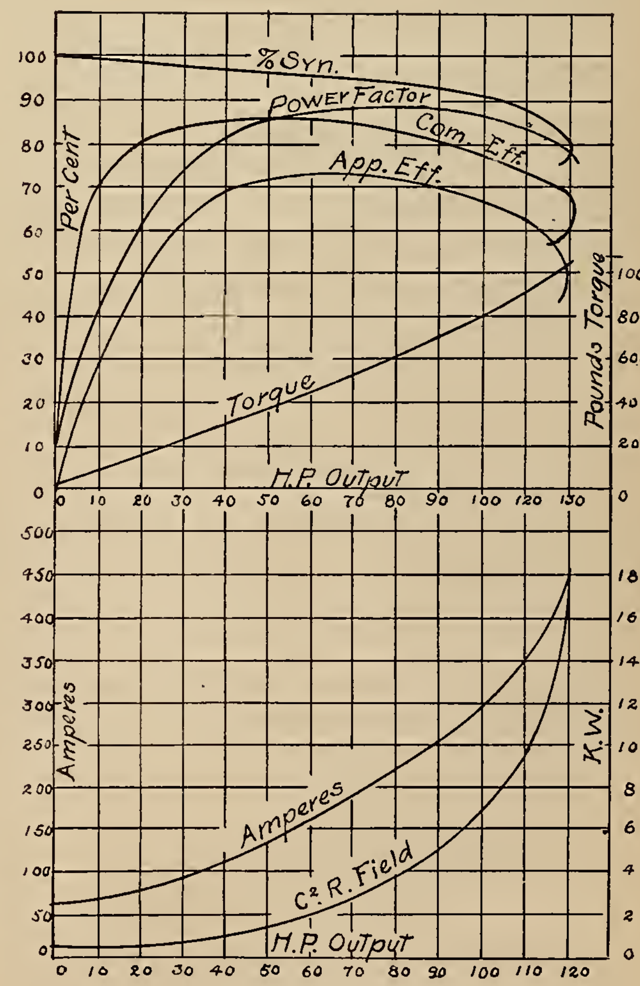

Fig. 12. Characteristics of 50-h.p. 220 Volt Motor.

secondary, then the total copper losses will be $2 I_2^2 r_2$. The other losses in the motor are the iron losses and the mechanical friction losses. If, for simplicity and for illustration, we take these again to equal the secondary copper losses, the efficiency of the motor would be

$$Ef = \frac{\text{Secondary Output}}{\text{Primary Input}} = \frac{\frac{I_2^2 r_2}{s}}{3 I_2^2 r_2 + \frac{I_2^2 r_2}{s}} = \frac{1}{3s+1} \qquad (4)$$

If $s = \frac{1}{20} = 5$ per cent slip,

Then $Ef = \frac{1}{0.15+1} = \frac{1}{1.15} \doteq 87$ per cent.

Equations 3a and 4 show the importance of slip on the efficiency, and 3a also shows that low secondary resistance is necessary for small slip.

Fig. 12 gives the characteristics of a 50 h.p. motor.

Fig. 13 gives the characteristics of a 2000 h.p., 6600-volt induction motor.

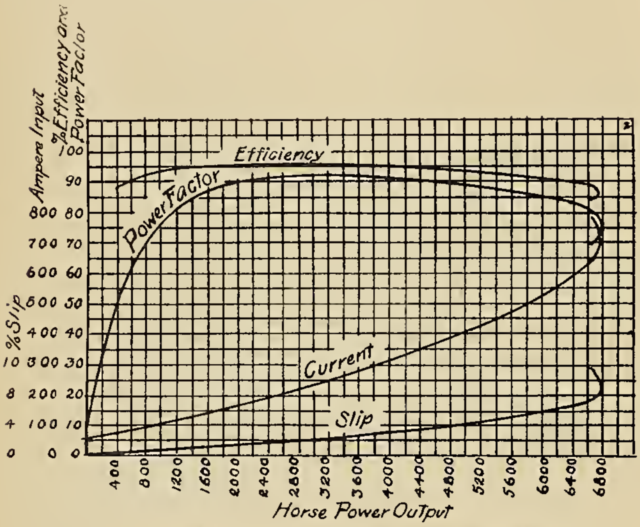

Fig. 13. Characteristic Curve of a 2000-h.p., 234 r.p.m., 6600 Volt Induction Motor.

The Induction Generator.

It will be at once seen that if the slip is made negative—that is, if the rotor of the motor be driven above synchronism, the e.m.f. generated by the rotor will reverse; that is, it would then require power to drive the rotor and in this case the induction motor becomes an induction generator. The points shown to the right of c'—Fig. 10—were obtained by driving the rotor above speed and measuring the current and power factor of the outgoing current. The current in the armature will again be

$$I_2 = \frac{s e}{\sqrt{r_2^2 + (sX_2)^2}} = \frac{e}{\sqrt{\frac{r_2^2}{s^2} + X_2^2}}$$

and the locus is on the circle as shown in Fig. 10. That is, from this figure one can determine the characteristics of the induction generator, and it will be seen that the characteristics of the induction generator are practically the same as those of the induction motor. In fact, by changing Fig. 13 so that the mechanical input gives the corresponding electrical output as to volts, amperes and power factor we obtain Fig. 14, which gives the characteristics of the induction generator.

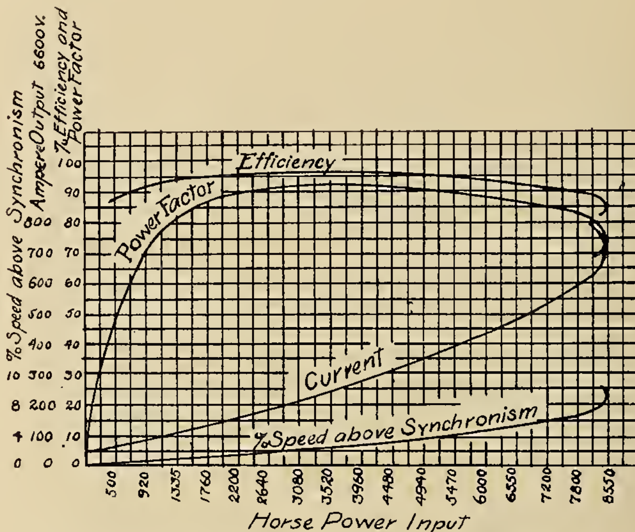

Fig. 14. Characteristic Curves of a 2200 h.p. 234 r.p.m. 6600 volt induction generator.

The induction generator cannot, of course, operate except in parallel with synchronous generators, and draws lagging current from the synchronous generators. The induction generator shown in Fig. 12 takes 30 per cent of full load current for excitation; as load is taken by the induction generator the power factor steadily improves.

The induction generator can have no effect in regulating the voltage of the system, and the regulation must be done by the synchronous machines. The induction generator generates power and the synchronous generator generates voltage. The disadvantages of induction generator is that it takes lagging current from the system for excitation and cannot help in regulating the voltage of the system. The advantages are, of course, that no exciter is necessary and the operation of the station is simplified. It is not necessary to synchronize; in fact, synchronizing is not possible. The station operator would, in starting, bring the generator up to near synchronous speed and close the switch, and then increase the speed of the unit until the desired load is obtained for the generator.

Fig. 14 shows what currents would be carried by the generator for given percentages of speed above synchronism.

If the unit should "run away" and the operator close the switch at maximum speed or any other speed, Fig. 14 will indicate the power which would be generated until the speed of the unit was brought to normal. The most dangerous point to close the switch would not be at maximum speed, but at the speed corresponding to maximum torque or maximum power generated. Closing the switch at this time might produce severe electrical and mechanical stresses, the con-

ditions being similar to throwing an induction motor on the line at full voltage without compensator or resistance; in fact, it will be noticed by an examination of Figs. 11, 12 and 13 that more sudden and severe strains will be thrown on an induction motor if it is connected to the line electrically when at some speed below synchronism, which gives a torque considerably larger than the torque at standstill. And, similarly, throwing the induction generator on the line when at some speed above synchronism will throw much more severe strain on the generator than there would be if the electric connections were made when the speed of the generator was about double synchronous speed.

Three-phase Induction Generator in Interborough Rapid Transit Plant, New York.

It should also be noticed that in throwing the induction generator on the line it will take several cycles for the induction generator field to come into proper interphase relation with the primary field, and hence, for several cycles there will be severe current rushes, which, however, should do no harm provided the electrical construction of the generator is substantial.

The field of application for the induction generator is limited to certain special cases, where the proportion of the total capacity would not be large. It has some advantages in large power stations in addition to its simplicity in limiting the surge voltage in switching, etc. However, a careful study of conditions should be made before installing induction generators, and they should not be installed, as were a few 25-cycle plants a few years ago, because some one else had done the same thing.

"ANY OLD KETTLE WILL MAKE STEAM."

BY R. N. MILLER.[1]

Everybody knows that. Where is the little boy who has not found it out for himself, while watching the kettle boiling on the stove and trying to stop the steam from coming out by thrusting sticks into the spout, only to get his fingers burnt for his pains? But will any old kettle make steam to the satisfaction of the engineer of a modern steam-plant or steamship? No; the engineer is looking for the most economical steam generator that the market can produce.

Let us briefly trace some of the evolutions of the kettle. Let us see what necessity and requirements have brought forth in the steam generator of today.

The earliest boilers were made of copper flasks with an opening at the top to which a pipe was attached for leading off the steam; such boilers were placed over an open fire. The steam generated by them was used by the ancients as early as 120 years before the Christian era to serve purposes of superstitious worship.

The first boiler to generate steam for any practical purpose was designed in 1655 by the Marquis of Worcester, who wished to generate steam to raise water for domestic and irrigating purposes and for driving water from mines. Because he considered the thing practical he was looked upon as a mad enthusiast. An extract from the description of his invention shows what he claimed and gives some idea of what he had to contend with:

"Invention 68—An admirable, most forcible way to drive up water by fire; not drawing or sucking it upward, for that must be as the philosopher calleth it '*infra sphaeram activitatis,*' which is but at such a distance, but this way has no bounder, if the vessels be strong enough; for I have taken a piece of whole cannon, whereof the end was burst, and filled it three-quarters full, stopping and screwing up the broken end, as also the touch-hole, and making a constant fire under it; within twenty-four hours it burst and made a great crack; so that, having found a way to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain forty feet high. One vessel of water rarefied by fire driveth up forty of cold water; and a man that attends the work is but to turn two cocks, that, one vessel of water being consumed, another begins to force and refill with cold water, and so successively."

The boiler designed by the Marquis was placed below the level of the water to be raised. His vessels, being filled by gravity, their contents were raised simply by the elastic force of the steam. He stated a measure of steam; one pound of steam would raise forty pounds of cold water.

Following the Marquis came Captain Thomas Savary, who raised water by means of the vacuum caused by condensed steam.

All early boilers were either globular or spherical, and were set upon an open fire. But that arrangement required an enormous quantity of fuel to produce a small quantity of steam. The boiler was heated, and so also was every surrounding object more or less heated. The first steps to overcome this evil and its great expenditure of fuel were taken by Dr. Desaguliers, who encased the spherical boiler in brick work, a substance which he says was a "good non-conductor of heat and calculated to withstand the destructive action of the fire." He formed a furnace under the boiler with bars of iron to hold the fuel and a pit to receive the ashes. Round about the boiler he formed a flue leading to a stack through which smoke and other products of combustion passed.

At that period the rating of power of boilers seems to have troubled engineers and manufacturers. A boiler horsepower was rated as six gallons of water an hour evaporated at a pressure of one atmosphere, or fifteen pounds upon each square inch. One pound

[1]Plant Inspector, Pacific Gas and Electric Company.

of coal was capable of evaporating 6.14 pounds of water.

Boiler designs improved greatly from that time on, and patents were numerous. The external appearance of the boiler was greatly changed. The ancient spherical was replaced by the cylindrical or rectangular tank or by combinations of both.

Newcom, Watt and Bottom were the first to stay the flat surfaces of their wagon-shaped boilers. Smeaton in 1750 is credited with being the first to introduce an internal flue; Trevithic, the first to break up the water space by the introduction of tubes. Oliver Evans of Philadelphia was the first to introduce high-pressure, cylindrical, external-fired boilers, and he was also the inventor in 1786 of the first high-pressure engine. The history of Evans consists almost entirely of the romance of real life. Sanguine and energetic, he continually encountered difficulties and overcame them, and encountered renewed disaster and disappointment till at length he died of a broken heart.

Even at that early date engineers seem to have had their troubles. The Commission of the Franklin Institute of America was appointed to report on the structure, phenomena, and explosions of steam boilers. That commission consisted of Professor Walter R. Johnson, Benjamin Reeves, and Professor A. Dallas Bache. They framed the fundamental rules for boiler construction. Here is an extract:

"Standard strength of boiler-plate 55,000 pounds, strength after riveting 2/3, strength after heating and cooling in use 2/3, strain of permanent extension 2/5, greatest practical strength $=2/3$ of $(2/3-2/5)=1/6$ (nearly) of the actual cohesion, and the greatest practical strength to prevent explosion, being four times more than any boiler should be ordinarily worked at, we have 2/45 or 1/22 of the standard strength of the boiler iron, as its ordinary working pressure; 2500 pounds of extension on each square inch of cohesion action may, therefore, be assigned as the safe working strain of iron boilers."

About this time the marine engineer first made his appearance. To him we are greatly indebted for the very great efficiency of the Scotch marine boiler as regards both performance and workmanship. At first ship owners were so pleased at having their ships making regular trips between ports, independent of the elements, that the great space occupied by the engines, boilers, and coal was for a long time not considered. But, with the desire to increase the steamship's earning capacity, the boiler went through many changes, from rectangular wet-bottom to rectangular dry-bottom, from combinations of rectangular and cylindrical to cylindrical with the introduction of water--tubes and smoke-tubes. Witherhed, an American, was the first to introduce superheated steam. But engine design had not progressed as rapidly as or even kept pace with boiler improvements, so super-heating had to be abandoned, as the steam raised to a high temperature was found to damage the valves and pistons of the engines and to burn the hemp packing.

It was not until 1859 that the Peninsula and Oriental steamship "Alhambra," plying between Southampton and Lisbon, was fitted up with Lamb and Summers super-heaters. The temperature of the steam as heated was only 360 degrees Fahrenheit, and the super-heater surface was four square feet the nominal horsepower. The report claimed a saving of 37 per cent of the coal consumption with super-heaters, but this saving was due to the extension of the heating surface.

Engine design had all along retarded the development of the boiler. But with the introduction of the compound-engine pressures jumped from fifteen pounds the square inch to one hundred pounds the square inch. With the further development of the triple and quadruple-expansion engine pressures have risen to two hundred and ten pounds the square inch and small boilers have been made to do the work of large ones. Forced drafts were introduced, first in a closed stokehold as introduced in the navy, then through closed ashpits as planned by James Howden, and lastly by induced draft in the stack as introduced by Ellis and Eaves.

In conclusion let us turn to the development of the water-tube boiler, which is now the boiler generally adopted for all purposes in generating steam. The Pacific Gas & Electric Company is so cosmopolitan in its ideas that it uses the following boilers: the Roberts, the Heine, the Babcock and Wilcox, the Stirling and the Parker. The first water-tube boiler recorded was made by William Blakeley in 1766. But the first successful user of the water-tube boiler was James Ramsay, an American, who, in 1788, patented a water-tube boiler for use in steam navigation. Here may be mentioned some of the earlier inventors such as Wolf, Stevens, Griffith, Eve, Belleville, Wilcox, Clark, Moore. Special mention should be made of Julian Belleville as a most persistent and prolific inventor. He commenced work on the boiler question in 1850, and for a time was comparatively successful. But in 1900 his boiler was finally condemned for use in the British navy by a royal commission.

Sir Albert J. Durstan, engineer-in-chief of the British navy, is to be highly commended for the stubborn stand he made, in spite of the opposition he met from the engineers of all countries, when, in 1894, he installed the Belleville boilers in the British men-of-was "Terrible" and "Powerful." There were forty-eight boilers in each of these warships, with twin engines developing 25,000 indicated horsepower. The writer did considerable work on the "Terrible," in translating and redrawing from the French metric to the British standards.

The patent records show that every maritime nation is credited with a patent water-tube boiler. Even the Japanese, the most progressive nation, use their own patent water-tube boiler in their navy. The principal types are the inclined-tube, like the Babcock and Wilcox; the bent-tube, like the Stirling; the water-leg, like the Heine; and the latest, the down-flow-type, patented by J. C. Parker. The Parker boiler is comparatively new, and has been very much criticized both favorably and unfavorably by many eminent engineers. But the fact that it is gaining headway and becoming a factor in the market proves that it has merit.

I would refrain from expressing an opinion on any boiler in case of controversy, but suffice it to say that the best kettle is the one that will stand up to its work and require the least amount of expense in maintenance.

THE PROGRESS IN OIL GAS MANUFACTURE.

BY J. M. BERKLEY

The progress and development of any commercial undertaking can be best measured by the results it shows on the balance side of the ledger, for commercially speaking, the balance side is the "watch dog" of the treasury.

To supply the need of the great Coast country—it being without coal, the mother of development in due time laid her hand upon her natural resources with the result that crude oil gas was born to do the will of man and furnish the comforts and advantages equal to other parts of our country favored with great mountains of coal. The name is quite as descriptive as that of coal gas for the same reason that it possesses within itself all that is required for production.

Great progress has been made in this new gas which is only a few years old. Its adaptability is evidenced by the almost general use on the Pacific Coast. California alone, according to Brown's 1910 Directory, shows sixty-five operating companies all delivering crude oil gas except one which is coal gas.

Many forms, or types, of apparatus are in use each with many claims to support their superiority. Some are almost freaks, being products of amateur minds and their operation only made possible by reason of the ease with which this particular kind of gas can be made. It is now coming to be generally understood that it requires more than merely heating the brick hot, on which oil is poured, splashed, or sprinkled to make a commercial success of the undertaking.

Coal gas has been in process of development more than one hundred years and long since reduced to well known scientific lines. The same is due to the large corps of engineers whose names have become monuments in industrial history, both past and present; and, as time goes on there will be added to the already illustrious list, of crude oil gas engineers, the names of others who by hard work and close application are lending hands that will make greater progress possible in the future and bring credit to the industry.

Water gas has also seen its day of fad and fancies until now it is a marvel of success.

Much remains to be done in the further development of oil gas as is evidenced by every day's facts around us. Oil itself will be responsible for much new work, for as time and demands make inroads on the supply, new conditions will present themselves, such as lower gravity, higher sulphur content, as well as the new uses for the products of refined oil made possible by improved methods of refining. Each will have a great influence on both cost of production and require new investment in apparatus to meet these on-coming conditions. We must not overlook these matters, especially in view of the agitation of the rate regulation now going on so vigorously and which is liable to become general, at least in California.

After crude oil gas is generated and passes the first washer, it is treated much the same as other gases; therefore, the real battle ground for development has been in forms and types of generators and washers, and there has been and is yet quite a difference of opinions as to which type is best. In a recent visit to fifteen towns outside of Los Angeles—ranging in population from 35,000 to 3500, thirty-four generating sets were found showing ten different types of generators in use. It is quite difficult to check their operation for in most cases they do not have station meters, the absence of which is also very noticeable even in some of the larger companies in California. Without the use of station meters to measure the output, it is as obviously wrong to set an array of figures to prove an operating cost as it would be for a merchant to tell just where he was at without the use of scales and yardsticks.

Oil from different fields will not yield the same amount of gas per gallon any more than coal from various fields will yield the same amount of gas per pound; therefore, it is wrong to expect uniform results even from the same type of apparatus under variable conditions. A classification of both oils and apparatus is greatly needed in order that we may get incontrovertible figures, then comparisons can be made that will compare.

The difference of opinions heretofore claimed for generator sets, composed of one or two shells, is evidently settling itself in favor of the one shell type as possessing all the functions required in the complete manufacture of crude oil gas. It was once thought that the whole operation could not be made complete in one shell nor would it be possible to get an arch that would stand the ravages of blasting and support the checker brick. The result is that there are in daily operation many such sets from four to twenty feet in diameter doing daily duty and that for several years past ,which is quite sufficient evidence. Such machines operate faster, cast less to build, less to maintain, with checker brick often lasting from twenty-four to thirty-six months, are easily kept free from carbon and naturally cost less to operate.

With the introduction of electric byrometers, used for obtaining internal temperatures, further advancement is assured with the result that speculation now finds no part in the heat required in generators; it can be easily ascertained and fixed to suit different kinds of oil. Using oil known as Whittier we have found the best results by maintaining an average of 1750 degrees in the vaporizing chamber, or space above checker brick, with a gradual increase down to the furnace where it reaches about 2200 degrees. With a change of oil to the Olinda field, we found we could lower our heats from 50 to 100 degrees on account of the oil fracturing at a lower temperature, thereby saving fuel oil.

Another important feature has been developed in oil scrubbing and has been brought to its high state of perfection by the company represented by our president. The efficient work of preventing naphthalene from getting into the mains is evidenced by a comparatively small percentage of complaints from that cause. It will well repay the time required to investigate the advantages.

In the matter of washers the best type is the simplest, that is, one producing even submergence and quick release with good facilities for cleaning.

The operator should not be overlooked as he is the most valuable asset in efficient operation. He should be educated so that he is a skilled workman

*Paper read at eighteenth annual convention Pacific Coast Gas Association, September, 1910.

and should know why he performs his duties. Intelligence is always superior to machinery.

Great possibilities no doubt lay ahead of us in the future use of lamp-black—the average gas man's nightmare. The manufacture of lamp-black into briquettes for fuel purposes is developing into quite an industry. In the manufacture of water gas it is finding a large use which will increase in the proportion of lamp-black productions.

It is quite evident that the time is not far distant when our present cherished ideas will be replaced by new requirements and the present methods will be the means of bringing to us better things. To the young men who are coming on with great opportunities before them, belong the privileges of bettering the pioneer work done by those who have passed and are passing and who have stood the brunt of battle and heat of day. The opportunities are sufficient to stir any one to the closest application for surely laurels of victory await the victor.

CRUDE OIL SMELTING.

The Washington Steel & Iron Company, Spokane, Wash., has commenced the construction of a plant at Leavenworth, Wash., 25 miles west of Wenatchee, to work the Rothert process for making high-grade tool steel from titaniferous magnetic ore by one operation. Exhaustive tests are said to have been made of the process in the experimental plant of the company at Hoquiam, which will be removed to Leavenworth. Crude oil will be used for fuel in the company's own specially constructed furnaces. A large mill site has been secured at Leavenworth which is ideal for the handling of the ore and the operation of a plant of large capacity. It will be but 15 miles from the ore beds and immediately on the railroad. It is stated that the company has near Blewett a deposit of 20,000,000 tons of iron ore. Associated with the company are M. A. Comer, of Wallace, Idaho, and J. L. Torkedson, O. P. Moore and E. K. K. Allen of Spokane. E. H. Rothbert is general manager.

CIVIL SERVICE EXAMINATIONS.

Examination for inspector of mechanical and electrical engineering is announced by the United States Civil Service Commission on December 7, 8, 9, 1910, to fill a vacancy in the position of inspector of mechanical and electrical engineering in the Supervising Architect's Office, at $2190 per annum, and vacancies requiring similar qualifications as they may occur in any branch of the service. The duties of the position consist of inspecting and testing the mechanical and electrical equipments entering into the modern Government or office building.

Examination for fortification draftsman is announced by the United States Civil Service Commission on December 7-8, 1910, to fill vacancies as they may occur. The usual entrance salary for this position is $1500 per annum.

Examination for cartographic draftsman is announced by the United States Civil Service Commission on December 7-8, 1910, to fill a vacancy at $3.84 per diem, Naval War College, Newport, R. I.

DISCUSSION OF PAPERS AT EIGHTEENTH ANNUAL CONVENTION PACIFIC COAST GAS ASSOCIATION.

"Progress in Oil Gas Manufacture."

President: Gentlemen, we have heard a very excellent paper. I would like to ask Mr. Egner, who has been traveling around the Pacific Coast during the past few months, and visited a good many plants, what has impressed him the most in the way of oil gas manufacture.

Mr. Egner: Mr. President, gentlemen of the Association; I came here to learn and not to talk. I came a very long ways. I listened to Mr. Berkley's paper and was very much interested in it. I can also say I have visited his works. I have visited a number of works, and I hope nobody will take exception when I say that I have not seen one so ship-shape, so well designed, so well kept, as the works over which Mr. Berkley presides.

Now as to oil gas, I was somewhat acquainted, about 18 years ago, in the old State of Illinois, with a process called the "Kendall process," something like what you have here today. It was about the first I ever saw, but you have made great improvements. I did not think it was possible to get the results that I find you are getting by making gas with the miserable stuff you call oil—the oil you are getting. If I had known I was going to be called on to speak I would have had a few more figures about this, but you all know so much more about oil gas than I do, that I know you will excuse me.

President: I would like to ask Mr. Jones what he considers the greatest improvements in the matter of oil gas manufacture in the last few years.

E. C. Jones: That would be very difficult to answer.

President: In your opinion.

E. C. Jones: I have listened to Mr. Berkley's paper with a great deal of interest. It deals with many generalities. The facts stated do not seem to call for an answer, but having been brought up with the old gas business from its inception, it having been forced upon me in the absence of other gas material, I feel it would not be right for me to remain in my chair without saying something. What Mr. Berkley says in regard to the absence of station meters in California is true. Unfortunately it is true. Mr. Berkley, of course, as an engineer, knows whether a gas meter is merely a guessing machine, depends on its accuracy by a test of a meter prover or small gas holder. If you measure gas with two large meter provers, and keep careful account of the changes of temperatures, you have a meter that cannot be approached by any other mechanical device. It bears the same relation to the measuring of gas as a gallon bears to the measuring of liquids. If you determine it contains 231 cubic inches, you feel satisfied that it is true. This is the means of measuring gas in many large gas works in California.

The next thing is in relation to the one-shell machine, which we call, in Southern California, the "straight-shot." I am opposed to it because I do not believe all the functions of gas manufacture can be performed in any one-shell machine. It has been tried for many years. I tried it in many ways and found that if the heat is applied to either the top or bottom of a one-shell machine, that there is a great deal of heat which cannot be used for gas making, and if heat is produced it costs money, and it should be used for the distillation of oil. Otherwise it is wasted. This, I claim, can only be done by an apparatus consisting of two or more shells—and gentlemen, let me say, there is not a bit of commercialism in my remarks. We are both gas men talking over without fear or favor what we believe. Some people tell us we should burn the oil in the bottom of a "straight shot" or single cylinder shell. If we do so we allow the top to become hotter than the bottom, and it becomes necessary for the gas in the bottom and middle to be taken out at the top, with a result that the gas itself is decomposed, with the result that we have lamp-black.

In the development of oil gas processes, it was found that what at that time was thought to be one of the hottest gases, viz: hydrogen, existed in large quantities; now, hydrogen, in the old days of coal gas, was considered very desirable because

it burned with a great deal of heat. This is true where we measure hydrogen by the pound, as it is very light, but when we measure it by volume it immediately drops to the value of carbonic oxide. There is one difference between hydrogen and carbonic oxide. Hydrogen is a false diluent. It reduces the specific gravity of gas and it compels the consumer to be very watchful or he will use much more gas than necessary. Now we find it is undesirable to have too much hydrogen in our gas; how shall we remedy it? By having a greater number of shells than one, conserving our heat, getting the heat equally distributed, and when the gas is finished taking it out of the oven the same as a loaf of bread. If you have an incubus of heat it must be used for some purpose, and the oil has to go through that in order to make gas, but don't compel gas to go through the hot zone and be destroyed.

In dealing with pyrometers, I find the Mr. Berkley is correct and incorrect. The pyrometer which is manufactured in this country and Europe is extremely valuable purely as an experimental instrument, but not to be relied upon in constant use. I have seen generators provided with electric pyrometers which registered a low temperature; at the same time there was being produced a good deal of naphthalene; the heat was not indicated by the pyrometer because the pyrometer was not in the right place.

The matter of oil washing follows naturally on the recommendation to use single shell machines. We all know that the use of oil for washing gas is not a good thing. The relationship between the hydro-carbons of which our gas is made—the elements that constitute our gas—is so great that there is a sort ot cousinship existing between all these hydro-carbons and when you take finished gas and wash it with oil all the cream of the gas gives itself to the oil. It is best to keep this cream in the gas even though it contains a certain amount of naphthalene.

I would like to tell you what we are doing in cities outside of San Francisco, but it would take up too much of your time to do so. I am simply considering the generalities dealt with by Mr. Berkley. If you see a "single shot" or straight or single shell machine, and you get a good deal of naphthalene, you must of course use oil in scrubbing it out—scrubbing out the naphthalene, and candle-power at the same time.

President: Mr. Latta, the convention would like to hear from you.

Mr. Latta: I want to say that I am so much interested in my visit to your coast that I am still in a condition of flux, and I have not been able to definitely formulate an opinion on the matter, and data which has come before me. In a general way, it is a great surprise to me that you are able to make gas in single shell machines. One reason is that the experience of water gas operators has practically conclusively shown that oil must be broken up at one temperature, and fixed at another and the fixing temperature is lower than the temperature at which they are broken up. Any tendency to reverse that operation invariably "cracks" the gas which has been made, and causes the production of the carbon.

I have had occasion to examine some experimental work which was being carried on by a very large company in this country for the manufacture of producer oil gas, the effort being to manufacture and produce gas by gradual dissolution within single shell, and this is the condition of affairs created: Their idea is to enter the oil at the top of the shell and break off each fraction of the oil as it goes down, increasing the heat and taking off the gases and lighter fractions without destroying the more delicate hydro-carbons. The result has been very satisfactory with the exception that a good many of the hydro-carbons are not properly fixed. This is because the time of contact has been too short, and the new elements have not had time to become permanently fixed. An attempt has been made to fix those by passing it down through the lower heat center, which practically made a single shell operation, and the result was more lamp-black, so it was given up as a commercial loss.

I am suggesting these facts merely theoretically. I may have no definite knowledge of the operation of your oil machines, but I am very much surprised and very much interested that you have been able to overcome these objections which seemed, from a physical standpoint, insurmountable.

President: I understand that Mr. Wade has some interesting data on the subject.

Mr. Wade: This is some very interesting data the speaker gave us, but the matter of the oil passing at the highest temperature is abolished under the single shell machine. The oil is actually spread and put in on the checker brick. The lower part of the machine is where the gas is taken off. The oil is spread in at the top and the gas taken off at the bottom. The lower part of the machine is the coldest part. The oil as injected burns in a flame something on the style of the Bunsen burner system, which is coldest at its lowest part. I think that is the way those results are accomplished. This question of fixing gas, I think, is more involved—considered more involved, much more, than it is. I do not just understand what the "fixing," as the gentleman stated, is. My idea of the thing is that as soon as the oil is decomposed it is fixed.

I agree with Mr. Jones that there is some solution of all valuable parts from the gas when it passes through oil, but I think that solution is made up by carbide, enriching the gas. There are hydro-carbons that are carried away, enriching the gas, so that anything that is dissolved is made up by hydrocarbons that are dissolved by the oil and taken out. That is the only way I can account for the fact that gas enters our scrubber at 601 units and is taken out at the same.

Mr. Britton: I would like to ask Mr. Wade, in this case—if that is the case—what is the good of the scrubber?

Mr. Wade: It removes naphthalene, which is solid hydrocarbon.

Mr. Britton: Naphthalene is the best illuminant you carry in your gas.

Mr. Wade: It is extremely difficult to distribute.

L. P. Lowe: What gravity oil do you use in the washer?

Mr. Wade: 20.

L. P. Lowe: That will volatilize at 150 degrees?

Mr. Wade: Its flash point is about 90.

L. P. Lowe: At what temperature would you put the gas into the oil?

Mr. Wade: 85 to 90.

L. P. Lowe: Under those circumstances you assume that you get volatilization of your lighter oils sufficient to overcome the loss due to absorption of naphthalene and other vapor?

Mr. Wade: The actual loss of candle-power is naphthalene is so extremely small in oil with a flash point of 85 to 90 degrees—it is so small that I do not think it can have any effect. I do not see how it can have any effect.

L. P. Lowe: Take gas of say 20 candle-power, carrying possibly six-tenths of one per cent hydro-carbon vapors, and remove them and what effect on the candle-power would their removal have?

Mr. Wade: Probably 25 per cent. That six-tenths of one per cent is extremely important..

L. P. Lowe: I think you take out very much more. I recollect a little uncomfortable experience I had before this association a number of years ago when I presented a paper entitled, "The Synthesis of Illuminating Gas." I prepared the seven principal gaseous constituents in bottles and showed and burned each one separately. In order to show all of the seven constituents, it was necessary to prepare ethylene, as the nearest approach to the so-called illuminants, and when I mixed this with the non-luminous gases in presumably the proper proportion, I was surprised to find I had only a practically non-luminous flame. I thought I could "steal a sneak" on the association, and quietly passed in about seven or eight times as much ethylene as there should have been, and was more greatly surprised to find it did not bring up the candle-power very much, and right there I learned a valuable lesson, which is that the illuminating power of our ordinary gases is largely due to the benzine and other hydro-carbon vapors contained therein.

Mr. Wade said a little while ago that he didn't know what "fixed" gas meant.

Mr. Wade: Of course I know what it means in this case—a gas that can be distributed at its original candle-power.

L. P. Lowe: A fixed gas is simply a gas that has no vaporous contents; once a gas, always a gas, and if you think you can permanently change it through physical means, you are much mistaken. You can simply so change the vapors, which never were gas. A fixed gas is a gas which will not alter its physical condition under ordinary conditions, but the vapors in that gas may deposit, and are deposited, with physical changes. If you can hold the naphthalene vapors in suspension you are retaining one of the most valuable constituents of your gas, and I believe it is possible to do so by simply removing a small portion of the water vapor, which is almost always present, after which the hydro-carbon vapors will remain in suspension.

Van E. Britton: From a commercial standpoint, is it worth while?

L. P. Lowe: Yes.

E. C. Jones: In discussing the relative merits of washing with oil or water, I had in mind a point where I am at present washing with oil, and it is compulsory—the conditions are such that we must wash with oil. It is compressed gas—under high pressure—and there is a difference of about two candle-power between the inlet and outlet of the oil washer. The loss in candle-power is approximately two candle-power. Now, I would like to say to Mr. Britton that we will suppose there is a municipal ordinance that requires 19 candle-power for merchantable gas. We will suppose that the municipality requires 19 candle-power. You have gone through the process of making your gas, using the standard amount of oil per thousand feet, and you find you have a candle-power amounting to 19. You put it through the scrubber and you have 17 candle-power. How can you comply with the requirements?

Mr. Wade: I wish to say one or two more things on this ethylene process. I think a good deal of it because it has certainly proved successful with the Los Angeles Gas and Electric Corporation. I took the trouble to get these details on naphthalene. This work was done by the University of Michigan in the Gas Fellowship, supported by the Michigan Gas Association. The amount of naphthalene which any gas or amount of vapor which any volume of gas can carry is measured by the temperature. Here I have the amount of naphthalene which can be carried by 100 cubic feet of gas at 70 degrees, which is 24 grains—that is the limit. I find 120 corresponds to .6 per cubic foot of gas. Six-tenths of one thermal unit can have no real effect on the heating or lighting value of the gas. Personally I think the heat value is the standard for modern gas purity. The Wisconsin Public Utilities Commission has adopted a single standard, and that, I think, is the tendency of all public utility commissions now. At the Los Angeles Gas & Electric Corporation, we are putting in gas of say 630 British thermal units, and taking out gas within practically one or two British thermal units.

L. P. Lowe: I think possibly there is something misleading in that statement, relative to the amount of naphthalene vapor which can be carried in the gas without depositing at certain temperatures. It depends on the presence of other vapors, does it not?

Mr. Wade: In the experiments carried on at the University of Michigan, they treated water vapor and benzol vapor, and there was absolutely no difference in the presence of water vapors, and but a slight increase in the benzol.

L. P. Lowe: Am I to understand that the gas was surcharged with water vapor?

Mr. Wade: Yes, sir.

L. P. Lowe: And that after removing the water vapor then, at 70 degrees Fahrenheit, would carry only 24 grains naphthalene per one hundred cubic feet of gas?

Mr. Wade: Yes, but it is a rapidly rising scale. The increase is very sharp. Let me give you one or two figures. At 70 degrees Fahrenheit 100 cubic feet of gas will carry 24 grains of naphthalene. At 80 degrees 100 cubic feet will carry 42 grains of naphthalene; that is a raise of 8 degrees. At 90 degrees 100 cubic feet will carry 71 grains. It goes up very sharp. The difference between 80 and 90 degrees is very big, and for that reason troubles increase very rapidly above 80 degrees.

L. P. Lowe: Have you any practical results of operation? Can you briefly describe your method of oil washing?

Mr. Wade: The scrubber is an ordinary 20 foot in diameter by 60 foot high power scrubber, with 2 by 4 timbers used as a spreading medium, laid at intervals of two feet—two feet apart, with about three or four inches between and they are circular and go up so as to make a complete revolution. The gas comes out at the bottom.

L. P. Lowe: Do you re-circulate the oil? Does the gas come in contact more than once? Is it a circulating system?

Mr. Wade: It is both. The suction from the bottom—the oil circulates from the bottom and takes new oil at the same time.

L. P. Lowe: Have you analyzed the oil to determine the naphthalene?

Mr. Wade: Yes, but I never could determine it exactly. It is very hard to determine on account of the vapor.

Mr. Britton: What is the temperature of the oil?

Mr. Wade: Practically the same temperature of the gas. In the summer 85 to 90, and in the winter 70.

Mr. Britton: Do you utilize that oil after it has been used for scrubbing?

Mr. Wade: Yes, we use it for gas making.

Mr. Lowe: I have heard a great deal of the various merits of various types of oil gas making machines but after all is said and done, the real point is the amount of oil used per thousand cubic feet, provided the gas is of proper quality. Now, if Mr. Berkley has no objection to stating his results of manufacture, I am sure it would be of interest and if he does not wish it recorded the reporter can elimiate it.

Mr. Berkley: I believe I will make a general answer to all of the questions that have been raised while I am at it, and at the same time answer Mr. Lowe's inquiry.

With reference to the objection that was raised this morning on station meters, I take issue with the statement that a station meter is not a necessary adjunct to the gas works, and that accuracy can be obtained by measurement of gas through the relief holder. If such be the case, it must necessarily be that two relief holders are in continual operation—no gas admitted to the holder while reading is being taken. Therefore, there must be one filling while the other is being emptied, and if there is only one relief holder I know of no means whereby any man has been able to mathematically calculate the amount of gas going into the relief holder and the gas going out, and give an intelligent answer. If this can be done, I will be perfectly willing to stand correction. If station meters are not a necessity, then it must also be admitted that every well regulated gas works in the United States has something it does not need. On the other hand, it is quite impossible to tell the difference between your gas made and gas sold without a station meter, and the discrepancy between consumers' meters and the station meter cannot be established either as leakage or defective meters. The reading of a relief holder calls into account human intelligence and accuracy which too often is unreliable. The man reading the scale board with graduations of 1000 feet or less will not at the end of the day be able to give a correct sum of his work, as would be the case by a well regulated mechanical device, such as station meters are today. If you do not care anything about the leakage question, then the station meter could be dispensed with, and your oil consumption per thousand feet of gas can only be calculated on the amount of gas you sell. Then the question would arise as to the accuracy of the consumers meters.

Now, as to the single shell generator, and why we advocate it.

Over four years ago, when I came to the Pacific Coast, I was employed by the Edison Electric Company. I went to Redlands to do some repair work. I found there two good types of machines, known as the Lowe type. After awhile I was enabled to travel over their entire system; I found several different makes of generators from one to two shells. At Riverside I found

a single shell generator, made some years before, in operation and having what was considered a super-heater in the top or upper half of it. I converted it into a "straight shot" machine by taking the arch out of it. It worked admirably and, I am told, is still working. Our machines in Los Angeles are built along the same line as that found at Riverside, and are the result of observations made while studying these different types. I learned at the same time the Los Angeles Gas Company was using single shell machines, and making a great success.

The question was raised that a single shell machine would not, or did not, or was not competent to make gas at one and the same operation. I am confident—so much so that I am willing to assert, without being a chemist, that oil gas is made instantly; for as quick as the oil meets the checker brick, which has been raised to a sufficient heat, the immediate result is the fixed gas—not condensible except for that portion which condenses into lamp-black and any other portion where not enough heat has been exerted on the oil. I also believe that the quicker you can get the gas away from the point of contact with heat after perfect distillation, the sooner you will solve the question of successful operation. I believe that the longer the gas is kept in contact with the checker brick, or heated surface, or extended over any further heated period, it is robbed of its high hydro-carbon, and thus made poorer, which proof establishes the fact that prolongation within heated enclosures does not add to its value.

The question of first cost is answered in that it is one-half of what it costs to build any two shell type. The cost of maintenance is less; checker brick lasts longer in single shell generators than it does in double shell generators for the reason that there is less stoppage. In the double shell stoppage often occurs in the super-heater, or auxiliary, and necessarily creates a heavy back pressure on the generator itself, also the residue from the incoming oil created during the period of blasting, causes stoppage by reason of the fact it cannot escape and thus the heat burns down the checker brick. We have had two shell generators go down in three months for the above reason. Of the single shell generators, which we are now operating, we have some that are on their thirty-second month, and have been on continuous daily operation and under the most severe tests when you consider that our machines go up and down twice every day, that is, during the period of making and cessation as they are in operation only about one-half the time. Therefore, the brick are subject to the most severe hardship that is possible, and I believe it is even a greater strain than continuous operation. It is also true that we get twice as much gas per man employed on the generators as we would in operating a double shell type, for it requires two men to handle two double shell machines, where it only requires one man to handle two single shell machines. There are no valves in between any of our apparatus, as we depend on hydraulics to take care of each shell, thus making each one independent of the other.

We also find that the statement of varying heat in single shell generators, and the same being incontrovertible; such is not the case, as our experience shows. We put our oil in at the top of the generator, where the heat is much less than at the bottom. Our average heat is about 1750 degrees Fahrenheit in the vaporizing chamber. As the gas descends, when finding its way out, it reaches a higher temperature or about 2200 to 2300; and, our observations are that during the run we do not lose any of the oil injected above for the reason that there is a sufficient amount of heat in the top of the generator to vaporize any oil that is going down with the gas near the end of the run. Therefore, as I have said, I believe the gas is made instantly and if removed at that point is just as much a fixed gas as if you run it through a mile of pre-heated storage. The cost of operation is greatly lessened.

L. P. Lowe: What is the gravity of the oil you use?

Mr. Berkley: Twenty.

L. P. Lowe: Whittier oil?

Mr. Berkley: Olinda, now. Our average heat units for the year 1909 was 608, and I think it is about the same now. The city gas inspector's tests are close alongside of those that we made, showing no particular difference between the two.

Now as to scrubbers. I want you to know, gentlemen, that I am not taking exceptions to any remarks made during the morning with any but the kindest of feelings. I am not here to argue from a personal standpoint—I have nothing to gain or lose. Like my friend Jones, I own no patents; I do not know what happens in the oil scrubbers, but I do know what happens in our complaint department. I know when we run our oil scrubbers continuously our complaints go down. The total number of complaints we have compared with the total number of consumers for the first six months of this year, and the average is 2.8 per cent. If we did not have oil scrubbers, I know it would be many times that. We do not use oil scrubbers in some of our outside districts, and we have as many as one-fifth of our consumers complaining at times. I am a firm believer in oil scrubbers. The technical side I am not here to discuss, but the practical side I stand for, and if we are robbing the gas by our method of scrubbing, unless I am very much mistaken, we are recovering it again because we pump the oil right back into the storage tanks, and it goes through again; and, therefore, if we are absorbing anything from the gas by way of valuable illuminants, we must be recovering them through distillation. We are not holding to the theory that we are making gas cheaper today than anybody else, or better, or that we have the latest apparatus. I believe, however, as I have said in my paper, that it is not far distant when the systems we now have will give way to better ones, and I am willing to take off my hat to the man who hurries them along.

L. P. Lowe: How many thousand feet of gas will you make per thousand fire brick?

Mr. Berkley: Well, that I do not know. In our generators there are ten thousand fire brick in each of them, that is, outside of the triple arches. Our arches are very strong, the radius being two and three-quarter feet. It requires several hundred brick to build the arches and to bring the top to the flat surface where we begin our checker brick. I have calculations on the number of fire brick and cubic area, but I did not bring the figures with me. I will be glad to furnish you the information based on thirty-two months of operation.

L. P. Lowe: Well, per thousand of brick.

Mr. Berkley: I can tell you another way to get at it; we have made 600,000,000 cubic feet of gas in the two generators in which there are 20,000 fire brick, and they are still in use and are in good condition. How much longer they will last I do not know.

Mr. Britton: What brick do you use?

Mr. Berkley: We use Los Angeles fire brick of the same class as used by other companies. I am glad you asked that question. This brings to my mind the question of pyrometers, which were referred to this morning in the discussion by Mr. Jones. I want to add that I am a firm believer in, and advocate pyrometers. I know of no other method that is equally as good and until I find something better, I certainly will remain of that opinion. There isn't any method that will give us, by observations, as close readings as pyrometers. We have our instrument fitted wtih four switches, and we take off simultaneous readings at two different points on two generators operating together. This enables us to keep close tab how each generator is working under the same blast and oil pressure.

I had an occasion recently to take a pyrometer test from a two shell generator set; I found that the heat in these separate shells varied greatly from one side or the other, and it is impossible to get the same even readings that we can from the single shells because of physical conditions. It is perfectly natural to expect easier operation from the single shell than from a double shell type. To prove this, while employed by the Edison Company, we disconnected a junior set of Lowe apparatus at Riverside, and took away the super-heater and putting the stack valve on top of the generator we made more gas with it. Of course, we put in new checker work and we were so much more successful than we were when connected together.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.
DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong
604 Mission Street, San Francisco

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

The Circle Diagram

There are two mathematical means of explaining the theory of alternating currents, the analytical and the graphical, which have about the same mutual relations as algebra and geometry, or more specifically as calculus and trigonometry. Some men actually think in calculus, just as they might think in German or in the metric system without need of translating into English words or into English units. A mathematical equation gives to them a vivid mental image of what is taking place in a transformer or motor, the different symbols clearly representing the relations between variable or indeterminate quantities.

There are many others to whom these equations mean nothing but tedious mechanical operations, but to whom the graphical methods bring ready realization of what is taking place. The brain can be reached more quickly through the eye than through any other sense of human nature. "Seeing is believing." Lines, curves, angles and areas appeal directly to the sight and help to visualize the problem. As regards simplicity and clearness they are like the sign language by which savage and civilized man alike can make known their wants. The graphical method is of value not only in explaining complex matters to a beginner, but also in giving the adept a mental picture which materially aids him in his more exact analytical calculations. For the graphical method has not the extreme accuracy of the analytical, giving results which are only approximate, but usually near enough for practical work. Adopting the chemical parlance, the graphical method may be said to be qualitative, while the analytical method is quantitative. A simple diagram carries conviction where mathematical manipulation cause confusion.

The circle diagram is one of these graphic ways of explaining the action of induction machines. Since its original development by Heyland in 1894, it has been somewhat simplified through various modifications and is now well adapted to the beginner's use. It is based upon the assumption that an induction motor may be regarded as a transformer whose secondary furnishes mechanical instead of electrical energy and which also has a large magnetic leakage. In plotting the current and voltage vectors of an induction machine under different loads it is found that the end of the vector, representing the primary current, moves in the arc of a circle as the load changes. Hence the name "circle diagram," the circle representing the locus of the current.

Aside from giving an optical illustration of the action of the induction motor and generator, the circle diagram is also one of the simplest means of obtaining the characteristic curves of these machines, showing the speed, torque, power factor and efficiency at various loads. While this method does not give absolutely accurate results, errors are so small that for all practical purposes they may be neglected, especially as they often tend to cancel each other. The diagram is laid out to scale and from it all the desired data can be measured. How this is done and why is admirably explained in F. G. Baum's paper on the "Induction Motor and Generator" as published elsewhere in this issue.

CURRENT COMMENT

The poorest heat conductors, aside from infusorial earth, are wood ashes and cement.

Telephoning from New York to Denver, a distance of 2200 miles, will be possible in 1911. The two cities will be connected by phantom loaded overhead circuits.

Calcium cyanamide, hitherto used chiefly as a fertilizer, is now being used as a substitute for potassium cyanide in the Clancy process of extracting gold and silver from unroasted sulphide ores by electrolysis.

The h.p. hour weight of a lead storage battery varies from 60 to 80 lb. while that of an equivalent compressed air storage system is over 200 lb. The Edison battery has even less weight but occupies greater space.

The cost of one c.p. hour has been estimated by a German authority to be equal to $w f + a / (s n)$, when w is the watts per candle-power, f the cost of a watt-hour in cents, a the cost of the lamp in cents, s the useful life of the lamp in hours and n the candle-power of the lamp.

Oil pipe lines from Coalinga include two belonging to the Standard Oil Company going to Richmond by way of Mendota; one, belonging to the Associated Transportation Company, leading to Monterey bay; another that of the Associated Pipe Line Company, extending to Port Costa; and the fifth, the property of the Producers Transportation Company, connecting the Coalinga, McKittrick and Midway districts with Port Harford.

Copper castings of high electric conductivity, free from blow holes and of all sizes and shapes are now being made in foundries by adding a small amount of boron suboxide to the copper when melted. The casting can be easily machined, is much cheaper than forged copper and less bulky than any of the usual alloys. This "boronized" copper has recently been developed by Dr. E. Weintraub in the research laboratories of the General Electric Company.

Boiler corrosion may be prevented by the use of zinc and tin according to the following method suggested in a paper by Carl Hambuechen at the recent Chicago meeting of the American Electro-chemical Society. An iron rod coated with tin and supporting zinc rings is tightly bolted to the inside of the boiler shell, the zinc being replaced as corroded. The tin by its overvoltage effect is always kept clean and consequently insures the good electrical contact necessary.

Triboluminescence, or light arising from friction, is exhibited by certain zinc minerals and in artificial zinc compounds such as a mixture of seven parts of powdered zinc carbonate and three parts of sulphur mixed with distilled water containing a trace of manganese sulphate. This mixture is first gently dried, then powdered and finally heated to redness for twenty minutes in a covered crucible. When scratched with a sharp point a train of yellow sparks are emitted which will not ignite a gas or vapor as does the alloy of cerium and iron perfected by Welsbach.

California's copper production in 1909 totaled 65,727,736 lbs., valued at $8,478,142. Shasta county was the largest producer, with 58,665,477 lbs.

An emulsified cylinder oil has much less lubricating power and must consequently be used in much larger quantities than a clean oil. The emulsion is also easily washed from the cylinder walls, which further increases the consumption.

The Paris-Madrid telephone line, 900 miles long, is expected to be ready before the end of 1911. Paris is already telephoning to London across the English channel, and equipment is now being installed to handle 400 messages daily.

The Heroult patents for electric steel making and refining in this country have recently been acquired by the United States Steel Corporation who have been operating 15-ton Heroult furnaces at South Chicago, Ill., and Worcester, Mass., for some time.

The Stia electrolytic meter gives a direct reading of the number of ampere-hours much as temperature is read from a thermometer. Electrolytic action decomposes mercuric nitrate, liberating metallic mercury which drops into a tube graduated to give the number of ampere-hours.

A wireless telegraph directory has been published by the Bureau of Steam Engineering of the United States Navy. It lists all stations throughout the world, according to country, giving call letters, wave length, power, range and character of station. Exclusive of foreign ships and of amateur stations, there are 1520, 700 being shore stations. The U. S. Navy maintains 47 shore stations and 344 ship installations.

An excess power meter for recording the amount of electrical energy consumed above a certain prearranged amount was recently shown at an exhibition of the Physical Society in Paris. On the axle of an ordinary meter is mounted a concentric nickel cylinder revolving between the poles of permanent magnet. The meter cannot start registering until there is enough current to overcome the counter torque due to the energy consumed by the hysteresis in the nickel cylinder.

Electric cooking has been strongly recommended by a board of U. S. Navy officers who recently conducted a series of comparative tests of electric ranges and coal ranges. Meats and vegetables for from 100 to 150 men were better cooked in almost half the time by electricity, no matter whether fried, boiled, broiled or baked. Ten pounds of meat were roasted in one hour and forty minutes by 7 kw. hours, whereas it required two hours and twenty minutes for 41 lb. of coal to accomplish the same result. The final conclusion of the report was that the electric range should supersede the coal range on board ship because of its cleanliness, economy of time, space, and operating, and elimination of coal boxes, draft troubles, soot accumulation and excessive heat in the galley.

PERSONALS.

George F. Maddock of H. M. Byllesby & Co.'s Portland office, arrived at San Francisco last week.

T. A. Work, of the Monterey Gas & Electric Company of Monterey, Cal., visited San Francisco this week.

Thomas Mirk, of Hunt, Mirk & Co., returned to San Francisco last Monday from a trip to San Diego.

Chester H. Pennoyer, manager of the National Conduit & Cable Company, left last Monday on a tour of Southern California.

Walter S. Allen, an official of the American Bell Telephone Company, of New York, was a recent visitor to the Pacific Coast.

R. W. Van Norden is making an examination of waterpower possibilities in Plumas county, California, for a foreign syndicate.

C. W. Waller, of the Mojave Water & Power Company of San Francisco, recently returned from a trip through the Pacific Northwest.

H. H. Noble, president of the Northern California Power Company, left for Redding last Wednesday on an inspection tour of the system.

H. L. Jackman, manager of the Humboldt Electric Light & Power Company, of Eureka, was a San Francisco visitor during the past week.

W. S. Heger, California manager for the Allis-Chalmers Company, returned to San Francisco last week after visiting his Los Angeles office.

S. N. Griffith of Fresno, who is constructing a new electric railroad in the San Joaquin Valley, spent a few days at San Francisco last week.

President J. A. Driffie and vice-president J. S. Torrance of the Ventura County Power Company, Ventura, Cal., have interchanged positions.

P. O. Crawford, electrical engineer with the Northern California Power Company, has returned to Redding after attending the varsity football game at Berkeley.

J. W. White, of the sales department of the Fort Wayne Electric Works, is making a business trip through the mining districts of Northern California and Southern Oregon.

Sidney Sprout returned last Tuesday from Oxnard, where he has been doing engineering work in connection with the electric plants of the Ventura Power Company's system.

Edward L. Haines, electrical engineer with J. G. White & Co., Alaska Commercial Building, San Francisco, has been appointed secretary of the San Francisco Section, A. I. E. E., for the ensuing year.

E. V. D. Johnson, general manager of the Northern California Power Company, who came to San Francisco last week for a slight operation following an automobile accident, is rapidly recovering at a local hospital.

J. Jenkinson, meter man with the British Columbia Railway, Light & Power Company of Vancouver, B. C., returned home this week after refereeing the Rugby football game between the universities of Stanford and California.

G. R. Field, assistant general manager of the Great Western Power Company, spent several days during the past week in the vicinity of the Big Bend of the Feather river, where a large plant is in continuous operation and improvements are being made.

C. E. Groesbeck, one of the vice-presidents of H. M. Byllesby & Co., of Chicago, spent the past week at San Francisco, conferring with representatives of his own and other corporations having extensive electric power interests on the Pacific Coast.

J. B. Adams, formerly in charge of the Pacific Gas & Electric Company's Colgate plant, has been made superintendent of the De Sabla Power Division, vice I. B. Adams, who has resigned to go to South America. The Colgate hydroelectric plant is now in charge of Joseph Mini, Jr.

Newly-elected associates of the A. I. I. E. include J. C. Albert, electrical inspector, Pacific Electric Railway Company, Los Angeles, Cal.; F. E. Alexander, electrical engineer, Anaconda Copper Mining Company, Butte, Mont.; E. J. Barry, electrical engineer, Potlatch Lumber Company, Potlatch, Idaho; R. R. Easter, operating department, Seattle-Tacoma Power Company, Seattle, Wash.; L. Edwards, shift operator, Vancouver Power Company, Ltd., Lake Buntzen Power House, Burrand, B. C.; R. W. Grigsby, consulting engineer, Los Angeles, Cal.; C. L. Hoon, electrician, Los Angeles aqueduct, Brown, Cal.; H. B. Lynch, manager lighting department, City of Glendale, Cal.; A. H. Noyes, electrician, Snow Mountain Water & Power Company, Ukiah, Cal.; J. Petersen, manager, Frank E. Harmon Co., Portland, Ore.; E. Popper, shift engineer in charge, United Missouri River Power Company, Butte, Montana; A. LeR. Taylor, laboratory assistant, University of Utah, Salt Lake City, Utah.

TRADE NOTES.

Standard Electric Construction Company has the contract for wiring the Pullman shops, at Point Richmond.

H. L. Harkness, Metropolis Bank Building, San Francisco, opened offices as manufacturing agents for contractors' supplies.

The Electrical Appliance Company of Portland has been absorbed by the Barretts Company, Inc., of 410 Morrison St., Portland, Oregon.

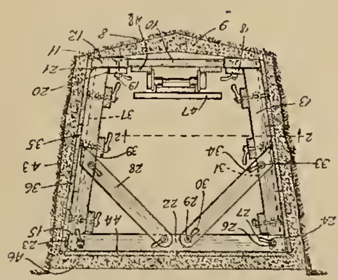
The Pacific Surety Company of San Francisco are adding a department for the insurance and inspection of fly wheels and boilers. C. M. Hausen, for the past two years manager of the Pacific Coast division, inspection department, of the Maryland Casualty Company, will take over the management of the inspection department of the Pacific Casualty Company, December 15.

The Pelton Water Wheel Company of San Francisco has sold to the Klamath Falls Light & Power Company a Pelton-Francis turbine water-wheel of 1050 h.p. which is to be direct connected to a Westinghouse generator operating at 400 r.p.m. The wheel will have a double cylindrical case and will operate under an effective head of 46 feet at the town of Klamath Falls. A Pelton oil pressure governor will be used in connection with a mechanically operated relief valve.

The Hydroelectric Company has purchased for its power plant on Mill Creek, near Bodie, an additional Allis-Chalmers 1500-kw. 2200-v generator. It will be direct connected to a 2500-h.p. Pelton impulse wheel which is to be operated under a head of 680 feet at 400 r.p.m. A Pelton automatic needle nozzle will be directly actuated by a Pelton oil pressure governor. The Fort Wayne Electric Works secured the contract for all of the switchboard equipment. The General Electric Company will supply all of the transformers. D. A. Chappell is president of this company which will start up its initial unit of 1500 kw. already installed, within a month or two. Current will be transmitted over the main transmission line at 55,000 volts. Two 600-kw. substations have been installed at Aurora and Bodie and extensions will be built to Fairview and Wonder, making about 75 miles of transmission line. The Bodie Consolidated has installed an electrically driven air compressor and will use Starrett pumps for mine drainage work.

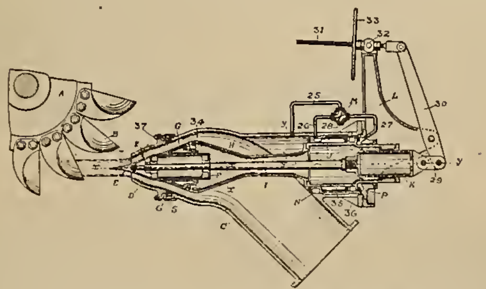
PATENTS

974,960. Apparatus for Making Conduits and Tunnels. John Phillip Grohs, Los Angeles, Cal. A form of the class described, comprising a frame having a bottom sill, rotatable blocks on the upper side of said sill near the ends thereof, posts stepped on the ends of said sill and abutting the outer



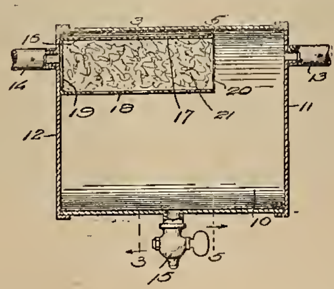
faces of said blocks, said posts diverging outwardly in an upper direction, the upper ends of said posts having seats formed thereupon, a beam resting on said seats, diagonal braces pivotally attached to said beam, means for detachably securing said diagonal braces to said posts, side-panels, and means for attaching the same to said posts.

975,350. Valve for Water-Nozzles. Frederick Gfeller, Oakland, Cal. The combination in a pressure discharge nozzle, of a convergent exterior shell and tip, an interior shell having its outer portion concentric with and approximating



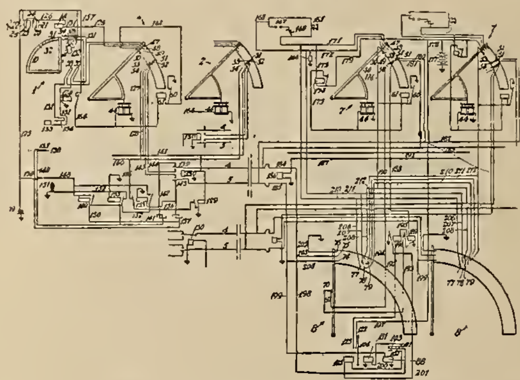
the shape of the outer end of the exterior shell, and having a cylindrical central opening, a pair of connected plungers fitting and reciprocal in the interior shell, and a convergent needle carried by the plunger and extending into the nozzle tip.

975,262. Gas-Filter. George S. Linn, Santa Barbara, Cal., assignor of one-half to Edwin S. Hicks, Santa Barbara, Cal. In a device of the class described, the combination with a cylindrical casing disposed on a horizontal axis and having drain openings at its lower side, of closing heads at opposite ends thereof, inlet and outlet pipes leading respectively from



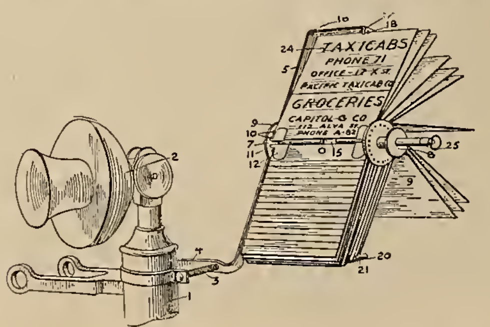
the heads, one of said heads having upon the inner side thereof, circumscribing the outlet pipe a transversely segmental strainer casing having a plane floor and arcuate upper wall concentric, with the wall of the cylindrical casing, the inner end of said strainer casing being disposed intermediately of the cylindrical receptacle, a screen member carried across said strainer casing spaced from the supporting heads, a second screen hinged to the opposite end of the strainer casing and adapted to close said ends, said plane floor having perforations therethrough and permeable material carried in the casing for collection of moisture in gases passing therethrough for drainage by gravity through the openings in said floor.

975,105. Semi-Automatic Telephone System. Charles R. Austin, Long Beach, Cal. A telephone system, comprising a central station, a plurality of sub-central stations, a plurality of subscriber's lines connected to each sub central station, each sub central station having automatic switch means responsive to selective impulses from the central station to connect one end of the subscriber's line to a line from the central station,



a plurality of selective impulse transmitters at the central station, each selective transmitter being adapted to send a selective series of impulses corresponding to one of the subscriber's lines at the sub-central station, and manual-switch means at the central station having an individual connection for each of the selective impulse transmitters, whereby the said manual switch means manually selects the selective impulse transmitter, and said transmitter automatically selects the subscriber's line.

974,957. Telephone-Directory. Wallace G. French, Oakland, Cal. In combination with a support provided with means for securing it to a stand or the like, upper and lower parallel members secured at one end to said support, the other ends of said members being free, a shaft rigidly secured at one end to said support and extending substantially



parallel with said upper and lower members, the other end of said shaft being free, a tube rotatably and removably mounted on said shaft, disks secured upon said tube, each having a circular series of recesses, memorandum cards and metallic clips secured upon adjacent corners of said cards and having reduced ends in said recesses, substantially as described.

INDUSTRIAL

MOTOR DRIVE IN A BOOKBINDERY.

The Williams Bookbinding Company of New York City in 1907 found itself seriously handicapped by an inefficient belt drive from the cellar source of power which supplied their two floors. In order to get better variable speeds and likewise do away with the loss of production from oil and grit falling from overhead shafting they took up the electric drive as a solution of their troubles.

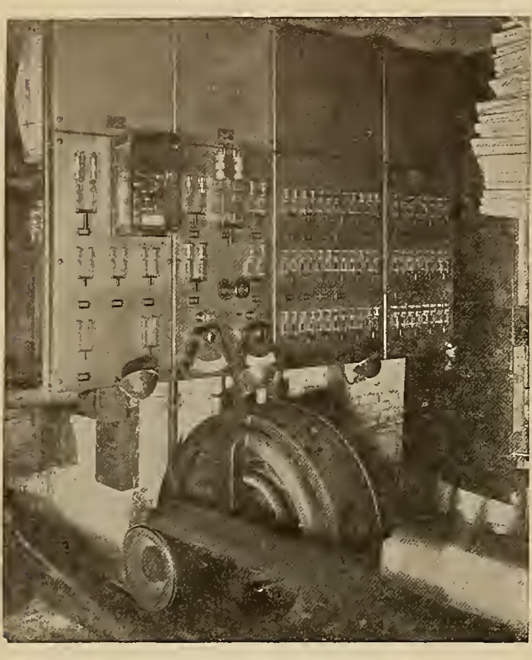


Fig. 1. 40 kw. Generator and Main Switchboard.

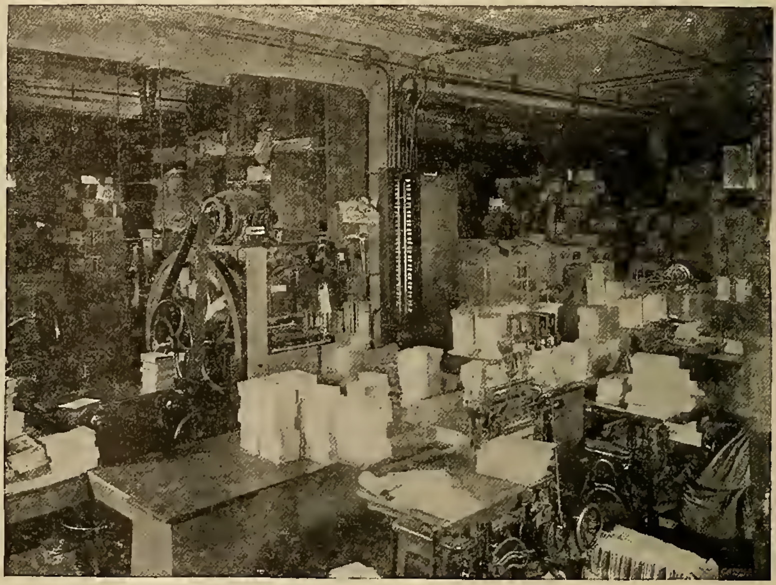


Fig. 2. General View of Fourth Floor.

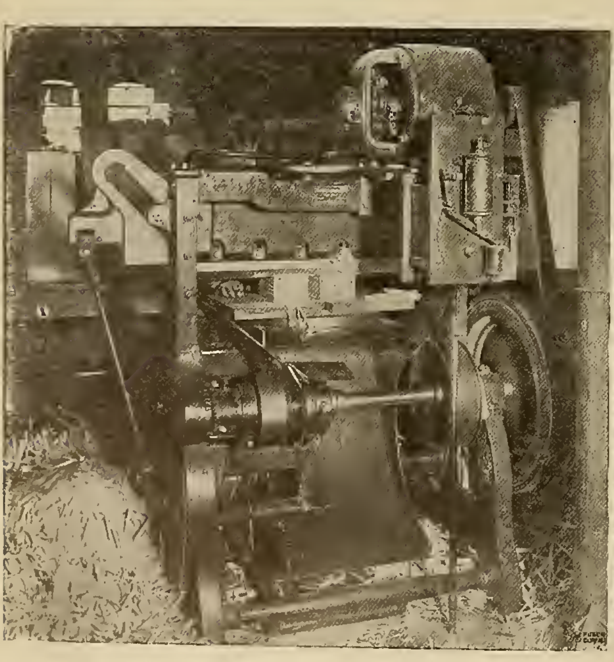


Fig 4. Paper Cutter.

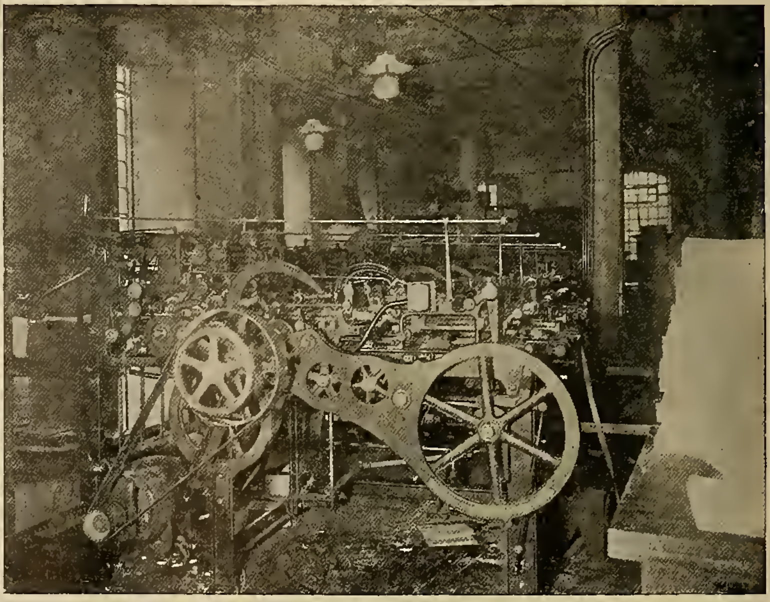


Fig. 3. A Group of Six Dexter Folders Fitted with Mechanical Feeders.

The generator is a 40 kw. 250 volt machine mounted on the ceiling and driven by shafting and belting from a slow speed Corliss engine in the basement. Directly underneath the generator, as shown in Fig. 1, is the main switchboard. The generator panel is provided with a main line switch, a 300 scale voltmeter, a 200 scale ammeter, a field rheostat controlling handle, and several smaller switches for the 230 volt lighting circuit. The panel to the extreme right is a feeder panel for the 230 volt lighting circuit and it also feeds the fourth floor distribution board shown in Fig. 2. A Thompson astatic totalling wattmeter is mounted on this panel. The two remaining panels serve as distribution boards for the lights and motors of the fifth or generating floor.

A battery of six Dexter folders with mechanical feeders is shown in Fig. 3. The motors for these folders are started and stopped by means of two-button push buttons, six of which are placed at different points about each machine, so that the attendant may stop or start the machine from any position. These push buttons control an automatic starter for the motor. A field rheostat is also installed, and by setting this the foreman can arrange for any speed, so that the

attendant need only operate the controlling buttons. The automatio starter, field rheostat, main line switch and fuses are mounted on a slate panel set up within the framework of the folder, but not visible in the illustration.

Fig. 4 shows a cutter, whose motor is started and stopped about once in every ten minutes. The apparatus is self-explanatory.

Fig. 6 shows an arrangement by means of which time is saved both in the frequent use of the hand starting rheostat and in the cumbersome method of pulling back the fly-wheel by hand. The reversing switch, when moved from the vertical, will cause the automatic starters to operate, thereby energizing the motor. When the foot brake is pressed down, the circuit will open, the operation being the same

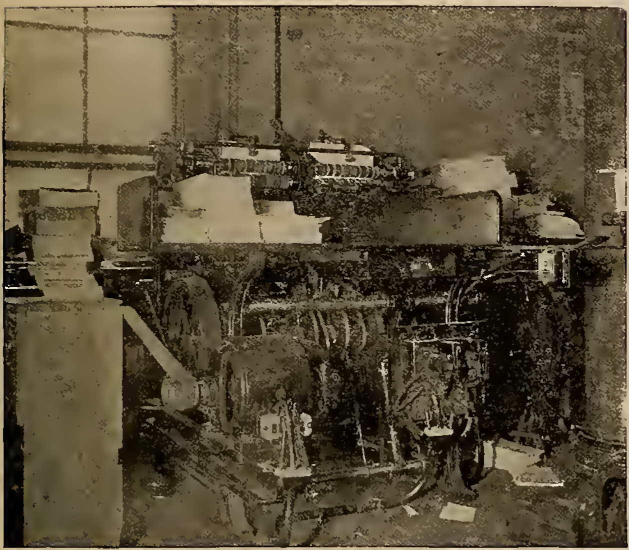


Fig. 5. Pasting Machine.

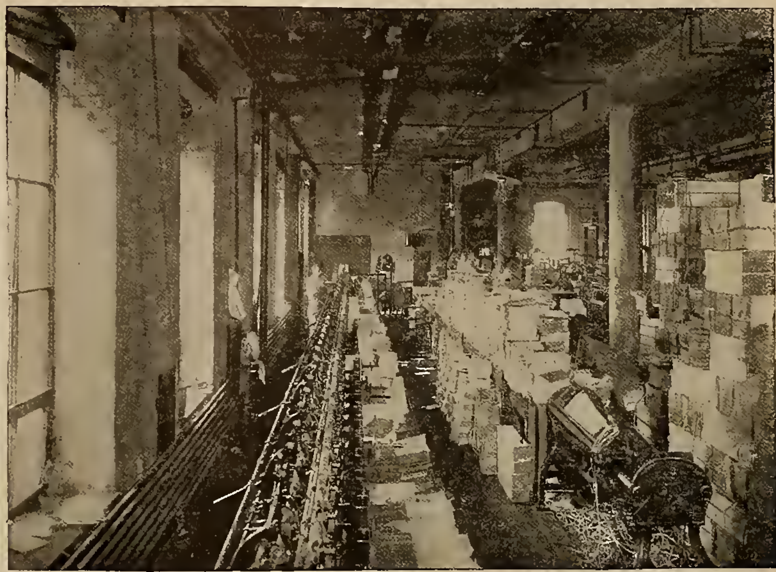


Fig. 7. Gatherer.

when the machine is reversed. The attendant keeps his foot on the brake most of the time. A field rheostat enables the foreman to set the speed for the output desired; this may vary from 30 to 90 books an hour according to size, shape and weight of material.

The makers of the pasting machine shown in Fig. 5 did not believe that this piece of apparatus could be operated by a motor because of the fact that it had to be stopped quickly and would require an unusually strong man on the brake. A motor, an automatic starter, and a dynamic brake made this machine manageable by a girl attendant, who needs only to push the control button.

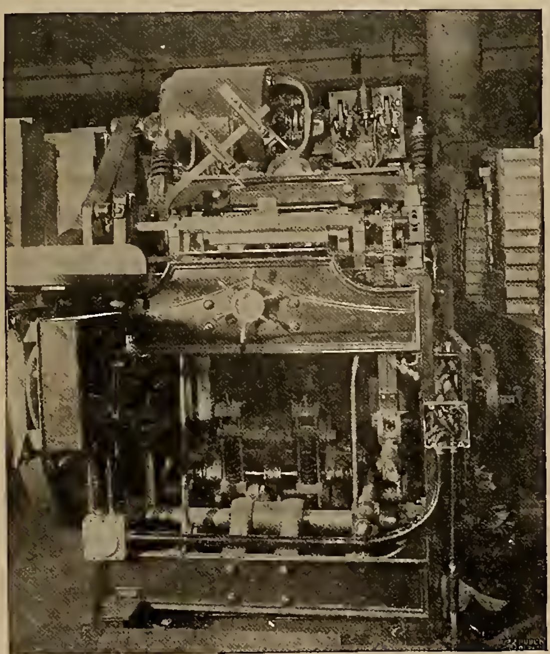


Fig. 6. Rounder and Backer.

A rounder and backer is a slow moving machine used for rounding the back of a book. As ordinarily equipped,, the electrical application consists of a hand operated rheostat, a motor, and a foot switch to open the holding coil of the rheostat when the brake is worked. When it is desired to reverse the machine, the fly-wheel is pulled back by hand.

A book is usually made up of from 25 to 60 sections which are gathered in proper order by a motor driven gatherer shown in Fig. 7, the operating buttons being located on the machine at the receiving end. The motor is mounted on pipe supports.

About 35 motors varying in size from ¼ h.p. to 5 h.p. are now in this plant. Small motors of one horse-power or less, operating machines which require practically no starting torque, are compounded and thrown across the line. These motors are started by 3-way snap switches which give full field before the armature is switched onto the line; this arrangement obviating considerable trouble from the blowing of fuses.

Nearly all motors larger than one horsepower are provided with automatic starting devices, the result of which is an increase of 15 per cent in the output for a given number of men and machines. This increase in production has not been due alone to the speeding up of various machines, but to the time saved through not having the employees concerned with starting the motors.

At first, when hand operated rheostats were used, the girl attendants would pull away from a rheostat handle when a spark occurred; several attempts usually being made before the lever was finally set on the holding coil. The male attendants, on the other hand, would hold the handle on a point until smoke came from the rheostat, when they would let the handle go and wait for the rheostat to cool. It was to eliminate these losses that the company installed automatic starting devices and the results have more than justified the expenditure.

Before the addition to the switchboard equipment of the totaling wattmeter mentioned previously, it had been the custom of the company and the owners of the building to arrive at an agreement as to the probable power requirements and to draw up a contract accordingly. The wattmeter

showed a 25 per cent smaller average load than that agreed upon and a corresponding reduction was made in the price for power.

It will be noted that some of the motors have to start under weakened field. To overcome this disadvantage 25 per cent extra capacity and compounding were added to the motors. With this addition, no trouble is experienced in starting up any position of weakened fields.

The electrical equipment of this plant is of General Electric manufacture throughout.

TELEPHONES FOR DISPATCHING TRAINS.

The telephone method of dispatching trains has lately been adopted on the Shasta Division of the Southern Pacific Railroad, where telephone circuits have been installed over 291 miles of road. The new method is being used over a 206 mile section of main line between Ashland, Oregon and Red Bluff, California, and a branch of 95 miles from Weed, California, to Klamath Falls, Oregon. The dispatcher is at Dunsmuir, California, which is 98 miles from Red Bluff, the southern terminal of the circuit. There are twenty-five stations on the entire circuit, twelve being between Dunsmuir and Red Bluff, nine between Dunsmuir and Ashland and four between Weed and Klamath Falls.

This entire circuit is composed of especially drawn 300 pound copper wire, metallic circuit. This telephone line goes through a mountainous region, and wire of extreme weight has been selected, not alone for conductivity but for tensile strength as well. This circuit during sixteen hours out of twenty-four is cut into two sections and during the third "trick" the entire circuit is operated by one dispatcher.

The apparatus for this dispatching system has been furnished by the Western Electric Company, which has made more than 90 per cent of the train dispatching telephones now in use in the United States. Passenger and freight trains on the Southern Pacific are equipped with portable telephone sets, enabling trainmen to get in touch with the dispatcher from any point along the road.

GREAT ELECTRIC DELIVERY SERVICE.

The recent electric delivery service installed by Gimbel Bros. of New York, shows a combination of hard-headed business economy, progressiveness, and a keen appreciation of the advertising value of swift, sure and silent delivery. Their initial installation covers a total of 66 vehicles, 36 of which are for small package delivery, and 30 for heavier service, ranging in capacity from two to five tons.

The entire line of vehicles was built by the Studebaker Company, and all are equipped with Westinghouse motors, controllers, main switches, charging plugs, and receptacles. The motors for the package delivery wagons are known as the Type V-20-A motor rated at 31 amperes, 50 volts, 1250 r.p.m. From this size the motors increase in size to the store truck which is equipped with two type V-30 motors rated at 80 volts, 35 amperes, 800 r.p.m. All motors are series wound, and all are provided with ball bearings. The vehicles are equipped with Westinghouse continuous torque metal drum series-parallel controllers, giving five speeds forward and five reverse.

Electric vehicles have now been in service long enough to pass the experimental stage and to demonstrate their great superiority over horse drawn vehicles and other tractors, especially for service in congested districts. From standpoints of economy, speed reliability under all conditions, durability, cleanliness, in fact from almost every conceivable standpoint the electrically driven delivery wagon has much the advantage.

In placing so large an order as that of the Gimbel Brothers, it was indicative of good business foresight to use the greatest care in selecting all vital parts of the equipment. Among these parts none was of greater importance than the motors and controllers; for successful operation of the vehicles these two parts must be of the greatest possible reliability and durability. They must be highly efficient, of maximum strength, and minimum weight; they must be built to withstand the most severe service conditions to which electrical apparatus can be subjected in the hands of unskilled operatives. The ordinary protection afforded by fuses or circuit-breakers is not desirable here, and moreover is not required, since the motors selected will take the full battery current without injury.

NEW CATALOGUES.

Compressed Air for Industrial Purposes is illustrated and described in Bulletin 4025 from the Allis-Chalmers Company.

Circular 114 from the D. & W. Fuse Co., Providence, R. I., is devoted to Subway Boxes of various types for exact ing service.

Bulletin No. 4769, entitled "Train Lighting with G-E Mazda and Tantalum Lamps," should be of interest to all connected with this branch of transportation.

Bulletin No. 9 from the Bowie Switch Company, Lick Building, San Francisco, illustrates and explains the use of Kilarc high-tension switches and circuit-breakers.

National Metal Moulding Company of Pittsburg, Pa., have issued an attractive catalogue and price list of fittings for this "ideal method of metal-enclosed exposed wiring." Detailed illustrated instructions are given for its installation.

In Bulletin No. 4780, just issued by the General Electric Company, is illustrated and described the Gem lamp which has a higher economy and greater illuminating power than the carbon, but is, of course, less efficient than either the Tantalum or Mazda.

Ad. Book No. 21, just issued by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., contains comprehensive, forceful advertisements of the company's general utility motor. The copy is intended to be of assistance to central station companies that are conducting campaigns to build up their day loads.

An interesting, well illustrated booklet has just been issued by the Westinghouse Electric & Manufacturing Company on the subject of Unit Switch Control. The circular, numbered 1189, explains the plan of operation of this type of control, shows complete wiring and piping diagrams, and discusses the details of the apparatus.

In Bulletin No. 4777, recently issued by the General Electric Company on the subject of "Building Lighting," many illustrations of both exteriors and interiors of buildings lighted by GE Mazda and Tantalum lamps are shown. In addition to these illustrations, there are data relative to the subject and illustrations of the complete lines of both types of lamp.

In Bulletin No. 4781, recently issued, the General Electric Company illustrates the series Mazda lamp, and offers considerable data, proving the advantages possessed by this lamp over the other incandescent lamps used for this purpose. The bulletin illustrates also various styles of fixtures used in connection with street illumination, and contains considerable data which will be of service to all interested in this subject.

The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., has just issued its Ad. Book No. 20, offering newspaper copy to the central stations that are booming electrical appliances. The book contains a complete collection of attractive and forceful ads, covering the Westinghouse Company's lines of toaster stoves, disc stoves, irons, luminous radiators, air heaters, bell ringing transformers, and Cooper Hewitt rectifiers.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—The West Coast Light, Power & Water Company, capital $500,000, has been incorporated by Albert N. Moughin, Alfred P. Dobson and S. F. Bradbury.

IRONDALE, WASH.—Articles incorporating a monorail system have been filed at Olympia by Walter Strange, Homer C. Meyers, capitalized at $500,000. It is the intention of the company to begin the immediate construction of a monorail railroad connecting Port Townsend and this place.

FINANCIAL.

KINGSBURG, CAL.—A bond issue of $26,000 for water works and fire protection for this city has been authorized by a vote of 106 to 24.

CORNING, CAL.—At an adjourned meeting of the town trustees last week an ordinance was passed offering for sale the $70,000 bonds voted recently to build water and sewer systems.

PASCO, WASH.—The Council has passed an ordinance for the purchase of water rights from the Pasco Reclamation Company, the proposed price of which is $50,000. General city bonds in the denomination of $5000 each are to be issued to take care of the purchase price.

LOS ANGELES, CAL.—The Council has voted to accept a modified contract for the sale of the remaining $8,250,000 bonds to the syndicate headed by Kountze Bros. and A. B. Leach & Co. of New York, of which $2,270,000 are to be taken at once. Money will be spent mostly on steel siphons for the aqueduct.

VALE, ORE.—Sealed proposals will be received by the Common Council of the City of Vale, Malheur county, offering the purchase of bonds in the sum of $35,000 to be issued in any sum not less than $100, nor more than $1000, for the purpose of installing a flow line to furnish said city with a gravity system.

SALINAS, CAL.—At the meeting of the City Council this week plans will be completed by the municipal government for calling an election to bond the city to provide a municipally owned and operated gas, water and electric light plant. The cost of the proposed improvements will be in the neighborhood of $125,000.

TURLOCK, CAL.—A special election will be held in the city of Turlock on Monday, November 21, 1910, at which time will be submitted the question of issuing and selling bonds in the amount of $15,000 for the construction and completion of a more extensive water system, and also for the incurring a bonded indebtedness of $10,000 for the construction of and completion of a more extensive sewer system.

TRANSMISSION.

LOS ANGELES, CAL.—The Desert Power & Water Company, is doubling the capacity of its electric power plant at Kingman, Ariz., at a cost of about $75,000 and is extending one of its supply lines six miles making its system aggregate about 32 miles.

TACOMA, WASH.—Messrs. Savage & Nichols have been awarded the contract for the building of the upper portion of the Nisqually power system. The work on which contracts have been let is the building of a dam in the Nisqually river and of a 10,000 foot tunnel. Chief Engineer Hamilton F. Gronen is of the opinion that the city would save 15 to 20 per cent on $300,000 or $400,000 worth of machinery if it should buy the machinery direct from the manufacturers. Commissioner Nicholas Lason of the department of light and water is anxious to buy the machinery separately and especially to let a contract for the transmission line.

WALLA WALLA, WASH.—A. S. Grenier of Portland, manager of the Pacific Power & Light Company announces that the company plans to build a power transmission line from here to Freewater country, which will furnish power for pumping water for irrigation of 11,000 acres.

SPOKANE, WASH.—D. L. Huntington, president of the Washington Water Power Company, announces that the company has purchased 7000 acres of land north and west of the Nine Mile, on the Spokane river and has about completed preliminary negotiations for building an electric power plant.

RED BLUFF, CAL.—Three deeds have been filed which conveyed to the Northern California Power Co. the right to construct, use and maintain ditches, flumes and tunnels, power lines and wagon roads across the lands of Elmer L. Fullwright and Willis H. Stone. Provisions are made in the deeds requiring the company to furnish gates so water can be used for stock and to provide adequate protection against the injury of stock. The lands are about 18 miles northeast of Red Bluff and evidently the lines to be constructed are from the south fork of Battle Creek.

WILLOWS, CAL.—A new electric company, which is being formed with C. R. Wickes as one of the prime movers and a number of local people as stockholders, has applied to the trustees for a franchise for a line through the streets of Willows, asking that the franchise be offered for sale. The company expects to get power from the Sacramento Valley Power Company, the latter's line now being three miles from Orland. If the local company secures the franchise its representatives promise to furnish the citizens of Willows with light and power within six months.

WONDER, NEV.—The survey of the electric power line to Wonder has been completed and contracts for its construction are to be entered into immediately. Some of the materials are already on the ground. The line is to be constructed by the Mono Electric Power Company from Lucky Boy to Wonder, a distance of 75 miles, and is to be completed by February 15, 1911. Current at a voltage of 60,000 is to be delivered to mining companies and other consumers for light and power. The company generates its power in Mono county in the Sierra Nevadas, and has had some trouble in getting a permit to cross a National Forest with its pipe line.

OROVILLE, CAL.—Filings have been made on large quantities of water to be taken from the Middle Fork, Falls river and Bear Creek in that section. A power house to generate electricity will be erected on a high hill near the junction of the Middle Fork and Fall river. Paul Rohrig has filed upon 20,000 inches of water to be taken from the Middle Fork of the Feather river near the junction with Bear Creek, in Plumas county, and to be conveyed by a 16-foot ditch for a distance of 22 miles to the junction of the Fork and Falls rivers. The appropriation states that a concrete dam 25 feet high, 10 feet through and 200 feet long is to be built at the point of diversion of the stream.

BAKERSFIELD, CAL.—Work on the new sub-station for the San Joaquin Light & Power Company at Twenty-fourth street and Union avenue is being completed as rapidly as possible and the officials of the company expect to have the plant ready for operation this week. Although neither roof nor sides have been put on the building, the machinery has been

partially placed in position and the walls and roof will be erected later. One 750 kw. generator and Curtiss turbine engine have been set up together with all of the boilers and other paraphernalia for running the big generator, which will be started about Tuesday and will supply an additional 1000 h.p. service to the city. Within about two months, another 200 kw. generator will be installed at the sub-station. The big machine was made by the General Electric Company and is being shipped to this city direct from the factory in the East.

OROVILLE, CAL.—One of the greatest projects ever attempted in California is to follow the absorption of the Great Western Power Company by the Pacific Gas & Electric Company, and if carried out successfully one of the biggest power plants in the country will result. It is projected to dig a tunnel four miles long from Big Bar to Bartel's Bar on the Feather river, and to get a fall that will generate as much electricity as does the Big Bend plant of the Great Western Power Company. A surveying crew under the leadership of L. P. Cornell is now engaged in surveying the proposed tunnel. It is estimated that the work will cost $10,000,000. If found feasible the work will be rushed to completion, as it is expected the Western Pacific Company may soon be a big consumer of power, as the Gould line officials are now experimenting with electric locomotives with the idea in view, it is said, to operate the Western Pacific trains over the mountains and across the deserts by electricity.

TRANSPORTATION.

LONG BEACH, CAL.—The Pacific Electric Company has been granted a franchise to lay a branch line on Riverside drive near Sixth street to connect the Union oil plant with the main line.

PRINEVILLE, ORE.—F. T. Hurlburt, a heavy stockholder in the Cline Falls Power Company, was in Prineville, after transferring the company's property at Cline Falls to a Redmond syndicate. It is understood that the purchasers had in view the construction of an electric railroad between Redmond and Prineville.

LOS ANGELES, CAL.—A franchise for the Pacific Electric Company on San Pedro street has been asked of the Council. It is proposed to run on that street and into the Pacific Electric station the interurban cars operated through the northern part of the city. The plan has been to have these cars enter the Pacific Electric building from the rear and on the level of Los Angeles street, which is considerably lower than Main street.

SAN FRANCISCO, CAL.—S. N. Griffith has been here to confer with the Western Electric Company on specifications for the electric installation work that will be necessary for furnishing power for the Fresno-Clovis electric road. He says that he will apply for a franchise from Fresno for the railroad which he proposes to build between Fresno and Clovis at the next regular meeting of the board, two weeks hence. The application for the franchise will not involve freight rights through Fresno, as these rights are no longer granted. Instead Mr. Griffith proposes to transfer his freight from the interurban line to the Santa Fe at a point near that city.

OAKLAND, CAL.—The Southern Pacific Company has filed a petition for a renewal of the Seventh street franchise, which expires November 11, 1911. The proposed line will be operated as an electric street railway and will be part of the gridiron system of electric suburban lines now being constructed by the company throughout the county. The petition was signed by the required two-thirds of the property owners along the right of way, which extends from its present western terminus at the Oakland mole to its eastern terminus at Fallon street. The life of the grant asked for is fifty years. The matter will come up for hearing on December 5.

LOS ANGELES, CAL.—The building of a municipal electric railway between the business center of Los Angeles and its harbor at San Pedro, on which individuals, firms or corporations may operate their own cars under the supervision of a commission, and upon the payment of proper tolls, is urged by Joseph Simons, president of the Simons Brick Company. He holds that the city should begin the construction of a steel road, and have it ready by the time power from the Owens river becomes available. The road could come into the city along the river bed, and have lateral lines, if desirable. With such a line in operation, a car could, he says, be sent to San Pedro and return, in connection with other cars, at a cost not exceeding $3.

SACRAMENTO, CAL.—War has been declared here by the Southern Pacific against the Northern Electric. The Southern Pacific has a band of men on guard at the intersection of Front and X streets in an effort to keep the Northern Electric from crossing the Southern Pacific tracks with its freight line, which, to hold the company franchise, must be completed by the 15th of November. To block the trolley road going across the steam tracks the Southern Pacific has had flat cars removed from trucks and spiked on the spur where the new road desires to cross. Old metal, pieces of machinery that weigh many tons and various other kinds of obstructions have been placed on the spot and a couple of engines are moving to and fro along the disputed territory to prevent encroachments by the enemy. The Northern Electric is building its freight line down X street and must cross the Southern Pacific to get on Front street in order to get at the new Northern Electric bridge building across the Sacramento river at the foot of M street. No move was made by the Southern Pacific until the trolley line reached the point of crossing.

ILLUMINATION.

TURLOCK, CAL.—The La Grange Water, Light and Power Company has taken over the holdings of the Turlock Electric Company.

PASADENA, CAL.—Manager Koiner of the municipal lighting department has been granted permission to purchase material and supplies amounting to $2850.

TACOMA, WASH.—The Snohomish County Commissioners have granted to L. F. Query a franchise to operate an electric light system at Stanwood, the plant to be placed in operation within a short time.

EUGENE, ORE.—H. H. White, manager of the Byllesby Company, and his engineer, O. T. Lawson, have completed arrangements for the erection of their proposed gas plant and other buildings here and for a power plant at Springfield, Ore., to cost about $350,000.

MODESTO, CAL.—The City Trustees have purchased the material and supplies for the Wisecarver addition street lighting system. Proposals having been advertised for, two firms, the Westinghouse Co. and the General Electric Co., bid for the electrical supplies. The General Electric Company's bid of $404.90 was accepted. This company submitted the only bid for wire. The contract for 14,000 feet of No. 8 wire at $172 was awarded them.

TELEPHONE AND TELEGRAPH.

BEND, ORE.—The Pioneer Telegraph & Telephone Company has begun installation of a telephone line from Rossland to Crescent.

SANDPOINT, IDAHO.—A crew for the Bell Telephone Company has started the construction of a telephone line at Bonners Ferry and are working north. The line will connect this place with Cranbrook, B. C.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 22 — SAN FRANCISCO, NOVEMBER 26, 1910 — PER COPY, 10 CENTS

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

JOURNAL OF ELECTRICITY
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VOLUME XXV | SAN FRANCISCO, NOVEMBER 26, 1910. | NUMBER 22

NOTABLE INVERTED TURBINE PUMP INSTALLATION

One of the most interesting features in connection with the great undertaking of the Sacramento Valley Irrigation Company in supplying water to 160,000 acres of farming land near Willows, California, are the inverted turbine pumps which have been specially designed to meet the requirements of large capacity for low head at a plant efficiency of 50 per cent. This vast irrigation plan, better known as the to describe, insomuch as it is of unique design and large size. The pumping plant is at the headworks of the main canal on the west bank of the Sacramento river. The river's low water level is from 5 to 7 feet below the normal water level of the canal as constructed by the Central Canal Company, so that pumping is necessary during the dry season, which is also the period of greatest water consumption. As the

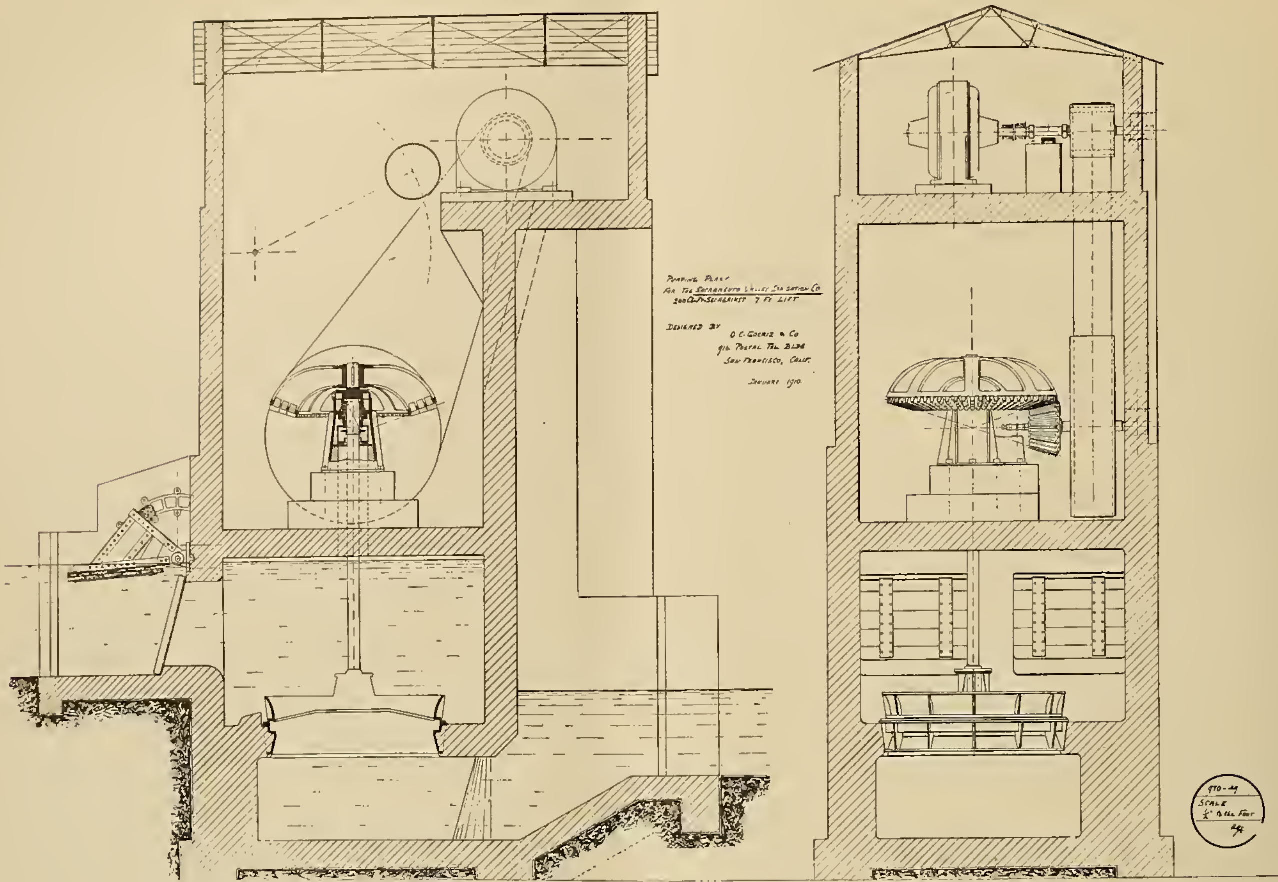
Pumping Plant of Sacramento Valley Irrigation Company.

Kuhn project, is the successful successor of the old Central Canal Company, whose canals and ditches carry water from the Sacramento river to some of the most fertile lands in Glenn and Colusa counties.

The present pumping installation consists of two units, a Byron Jackson centrifugal pump previously installed by the Central Canal Company, for a normal capacity of 100 cu. ft. per second and temporarily speeded up to furnish 150 cu. ft. per second, and the inverted turbine pump having a capacity of 200 cu. ft. per second, which it is the purpose of this article

water falls, the pump must operate at heads varying from four to seven feet.

As can be seen in the line drawing, the pump is driven by a 300 h.p. Fort Wayne induction motor with an extended shaft and flexible coupling placed 26 ft. above the extreme normal low water. The speed variation required for pumping against the different heads caused by a fluctuating water level is accomplished by using different pulleys and a belt drive, a belt tightener taking up the slack when smaller pulleys are used. It is thus possible to obtain variable



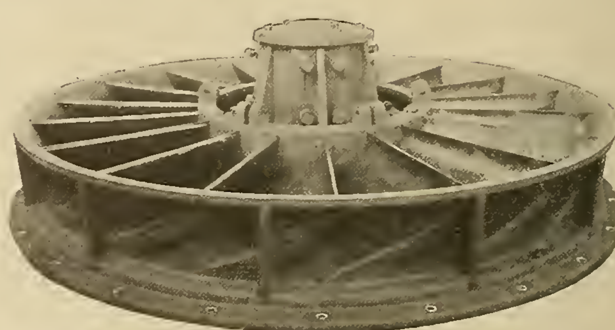
First Turbine Pump Unit in Plant, Sacramento Valley Irrigation Conpany.

speed from the constant speed induction motor. The power is further transmitted from the horizontal jack shaft to a heavy mortise-bevelled gear wheel, which is keyed to the vertical pump shaft.

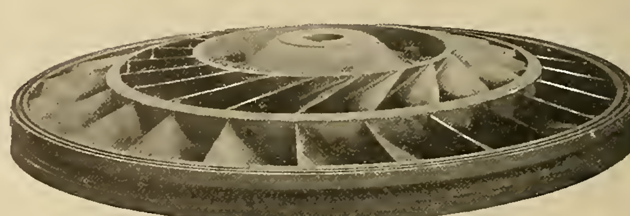
The pump is an inverted axial flow turbine whose details are shown in the accompanying illustrations of the three main castings. The inlet or lower section is provided with straight vanes leading the water to the revolving runner above it. This runner casting consists of two sets of vanes, an inner set cast homogeneously with the inner and middle rim, and an outer set of steel blades between the middle and outer rims. On top of the runner is the diffuser designed so as to lead the water gently in the vertical or axial direction of the shaft. The pump is set in a concrete chamber, low enough to be primed at any time.

The discharge is through two hinged gate-valves, each about 4½x6 ft. which serve two distinct purposes. When the canal is empty there is but a slight head above the pump and the great volume of water discharged at the speed selected for the maximum head would tend to overload the motor. In such a case the gate can be blocked so as to give a certain maximum opening through which the water is discharged into the canal. Again, in case of possible failure in power supply these gates act as check valves, allowing only the water in the pump chamber to flow back to the river.

So satisfactory were the initial tests conducted during the past summer on this set, that it was decided to install three more units of the same capacity. The layout for the new units will probably be modified by using vertical motors and pinions, directly engaging with separate gear wheels keyed to the pump shaft. Thus it will be possible to dispense with the



Diffuser.



Revolving Runner With Two Sets of Vanes.

Inlet Section With Straight Vanes.

belt drive and effect speed variations by using pinions of different diameters. Such a layout will be even more efficient than the present unit with belt drive and bevelled gears. The installation is expected to give a 50 per cent plant efficiency (water horsepower represented by the lifted water divided by electrical input into the motor). This makes no allowance for the velocity head which would make an additional two or three per cent in plant efficiency in such a low head pumping proposition. This pump was designed by Mr. O. C. Goeriz, hydraulic engineer, San Francisco, and the intricate castings made by Joshua Hendy Iron Works of San Francisco. D. W. Ross, formerly State engineer of Idaho, is chief engineer for the Sacramento Valley Irrigation Company, and A. L. Collins acted as supervising engineer.

GAS LEAKAGE.[1]

BY GEO. KIRK.

So much has been written on the subject of gas leakage and the ground so well covered that I feel unable to do the matter justice, but will endeavor to call your attention to some few points I have observed during my experience of nearly thirty-six years at one plant, which today sends out five million cu. ft. per day as its minimum.

Too much care cannot be taken in installing mains. Only men who are good mechanics and thoroughly reliable should be employed on this work. They should take as much interest in their work as if it was their own private property. When I started with the Oakland company nearly thirty-six years ago, it was a small place and at that time the largest pipe was 8 in., and not much of that. We, like a great many small plants, had to depend on San Francisco to send men over to lay mains and only one or two blocks at a time, and as a general thing they were not as careful as they might be, knowing that they would have no trouble in the future. As the place grew, however, and we were able to have a steady crew of men, who were responsible if anything was wrong, conditions changed and we had first class work. Now we consider that we have about as tight a system of piping in Oakland as there is in the United States.

One of the first points in stopping leakage is to furnish a man with good tools to do the work and then see that he does his work right at the start. In the first place, in using yarn, I have found in my experience that the best yarn is tarred hemp. When that is properly driven home and about 1½ in. of lead well caulked in, the pipes are not apt to leak, providing the other mechanical principles of pipe laying are properly carried out, namely, if the pipe is properly and solidly blocked, every joint brought home iron to iron, and correct alignment of the pipe in the ditch properly looked after. In cases where conditions make it necessary to swing a line of cast iron pipe without using bends, care should be taken in chipping off the bead end so as to still maintain a solid joint.

I cannot emphasize too strongly the necessity for blocking pipe solidly. In digging a ditch it sometimes becomes necessary to change your grade after the ditch is finished. In all cases the blocking should rest upon the solid, undisturbed ground, and not on some freshly, filled or tamped earth. There should be two blocks under each length of pipe as near to the end as possible without interfering with caulking.

Contraction and expansion cannot be said to have any appreciable effect upon our leakage, as in our climate the temperature below the ground at the depth which we lay our mains varies only a small amount between the winter and the summer and therefore can hardly be called a source of trouble in our leakage department. We did have one instance, however, of expansion and contraction causing leakage, which might be of interest. It is, however, an exceptional case.

A report of no gas in a certain district caused investigation of the drips in the neighborhood, which developed the fact that a drip on a 4 in. line was full of water, and the water was coming in so fast it was necessary to station a man at the pump continuously in order to keep a section of town from going out of gas. As this was the first storm of the season, I figured that that water must certainly come from the high ground where we had laid some mains during the previous summer. We followed up a 4 in. main, which for a short distance passes through a territory thinly settled, in order to reach an isolated group of consumers. We soon discovered a leak of gas. On digging it up we found that a 2 in. wrought iron lateral main, which was screwed into a 4 in. plug in a tee, had pulled the plug out of the bell enough to cause a leak all around the joint. The whole instance of the laying of this pipe was then called to mind for it was during a spell of weather warmer than usual, and the man in charge of the work had left too much ditch open. The first rain had, of course, chilled the pipe, causing the pipe to contract, pull the plug out, and the water running into the pipe gave us immediate notice of the leak.

Concerning the matter of tapping holes. Thirty or forty years ago they had a very crude way of tapping their pipes. In some instances they cut their hole with a diamond point, then reamed it out and then tapped it. I believe there are still some companies that do it that way at the present time, but with the new tapping machines up to date, men can do better work and save time and gas as well.

This matter of tools and general equipment for the men is one of such importance that I feel it cannot be too strongly emphasized. It is not only from the point of view of the mechanic that good tools make a good job, but it is as well a moral question with the men. If you equip a man with a good set of tools of every description, all of the latest up-to-date improvements, including the labor-saving devices and so forth, you encourage that man to do the best work possible, for every true mechanic, no matter what his line of work may be, takes a natural pride in the tools of his trade. This is especially true in street main work of the service man, who uses the largest variety of tools. I do not mean to state that a fine set of tools will make a first class mechanic out of a careless, slovenly worker, for I have, during my experience, on some occasions found a line of wrought iron pipe or a service put together and about to be filled

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, September, 1910.

in, with every joint leaking. A time card is the only remedy for such cases.

I find that the heavy pressure that we carry now is more liable to cause leakage than when we only carried from three to four inches water pressure. It used to be the practice of our company to shut the pressure off at 10 o'clock, keep a light pressure, say 3 in., during the day and then turn on the heavy pressure at the peak load in the evening, but now our consumption is as heavy in the day as it is at any time owing to so much gas being consumed for cooking and manufacturing purposes.

In our city the last two or three years there has been considerable leakage caused by contractors grading streets and plowing up our pipes, without taking proper care, but on all occasions we have endeavored to have men on the ground to see that the flow of gas stopped as soon thereafter as possible. We of course always have men available, whose location is definitely known, that can be rushed to the scene of such trouble. In our district we have a couple of men whose duty it is to make a careful inspection of all our high pressure regulators, and we have these men for this emergency work, since their regular rounds can be arranged so that they can be located at any time of the day, and in any case where their work makes it necessary for them to change their regular round of work, they notify the office at once by telephone. This method is satisfactory in looking after emergency cases such as small jobs done by sewer contractors or house movers. In cases, however, of big jobs of street grading, the only absolutely safe way is to have a representative of the gas company on the ground all the time, and follow the contractor's work as long as they are doing the plowing.

We have had some trouble with leakage in our high pressure system due to electrolysis, but it showed itself so rapidly when it did leak that we had very little trouble in finding it and repairing the leak.

When I started with the Oakland Gas Company, the price of gas was $4.50 per thousand, and as our send-out was small, a leak was a very serious matter at that price. I will recall a few instances of leaks that occurred in the early days, and the method we employed to find and remedy them.

The following is our experience with a high pressure line which was laid over twenty years ago, and speaking of high pressure, I think this came pretty near being the first installation in this country. This line crossed the estuary from Oakland to Alameda.

Our first installation consisted of two 2½ in. pipes, which were imbedded in the mud as far as we were able without resorting to dredging. The result was not at all satisfactory, for every time a large ship passed through the drawbridge we had trouble. They had a method of dragging their anchors as they passed through the draw, to prevent hitting the sides of the bridge. They usually missed the bridge but very seldom missed our pipe, with a result that we were continually making repairs after they had pulled the pipes apart. This under the best of conditions, of course, was a source of considerable leakage. To avoid this Mr. Britton had an 8 in. pipe laid from the works around by East Oakland and under the canal bridge at Park street, Alameda. The pipe was put down for the purpose of replacing the original one, which was smaller, and at the same time to provide a permanent crossing for the canal to prevent the trouble above referred to. We tested it with air pressure and carried an average of 30 to 35 lb. pressure, and we haven't discovered any leakage to amount to anything for years. In carrying pipe across the creek, which is about 500 ft. wide at that point, we had to sink our pipe 7 ft. below the bottom of the canal, and imbed it in concrete 18 in. thick. It worked satisfactory for years, but after it had been in service for about six years, we found that the drip filled up so fast that we couldn't keep it pumped clear. We then made the necessary preparations for repairs, and after we had the water drained off, we dug down to the pipe to find the leak. There was about 4 ft. of mud before we got at the concrete. We opened the concrete in several places and found the pipe in perfect condition. The paint that we had on before it was covered in the concrete was just the same as when we put it on. After considerable prospecting, we discovered that the salt water had reached the wrought iron pipe, that we brought from the drip, through the seam in the concrete where the top and bottom of the concrete had been put together, and had eaten out the 1¼ in. drip pipe. We dug down to the drip pipe, had a redwood box, 12 in, in diameter made, and put the 1¼ drip pipe in, filled it up with concrete, and covered it up. From that day to the present we haven't had any trouble. We still use the same pipe to carry from 30 to 35 lb. pressure, and it still seems to be in good condition. This is an 8 in. C. I. main with lead joints, running from the works, where we manufacture the gas, to our holder in Alameda, which is about seven miles.

My first experience in leakage in Oakland was as follows: There was a leak that had been bothering the company for some time, and as mentioned before, the price of gas at that time was $4.50 per thousand, we started in to find it. It had been reported for several months that it was a wooden sewer in the street, but at last I got some men and started to dig up the 3 in. main in the street and found the pipe had broken in two. I fixed that and the people in the neighborhood were happy.

My next experience was in regard to a drip at Telegraph avenue and Twenty-third street. In the winter when it was wet we had to pump it out at 6 o'clock in the evening and before 10 o'clock the entire district was shut off of gas by water in the drip. That bothered us for some time, but accidentally we started to put in a service at Telegraph avenue and Thirty-sixth street and found that some men in putting in a sewer had punctured our pipe with the sharp point of a pick, and evidently had patched it up with a piece of clay, and never reported it. After that was fixed we never had any more water in the drip at Telegraph avenue and Twenty-third street.

The next experience was on a Sabbath morning. A man called up the superintendent's house and reported a bad leak in a main. He said he saw it bubbling up through the earth, and he wouldn't tell where it was unless the superintendent would pay him $2.50, which he refused to do. As soon as possible the superintendent came to my house. We hitched up a horse and buggy and drove all over the mains where

we thought it might be, but failed to find any leak that day, but shortly afterward while going to Alameda, on the other side of the Webster street bridge, I discovered a leak of gas. It was an old ¾ in. service that had been eaten away by the salt soil, and we found later that this was the leak that the man wanted $2.50 for. The highest pressure we carried on our mains was 4 in.

Another experience was in East Oakland. A leak was reported on Fourth avenue and East Twelfth street and on Third avenue and East Eleventh street. The gas was coming up through the sewer pipes so that the people could hardly live in the house. We had investigated it and spent several days trying to locate it, but we couldn't find any trace of it. At length the street caved in between the street car tracks on E. Twelfth street, between First and Second avenues, and there we found that in filling in the sewer that they hadn't tamped it and the pressure of the earth on top broke our ¾ in. service pipe and the gas escaped from that into the sewer, and went for blocks. We fixed that and afterwards had no trouble.

Still another experience was in North Oakland, where our temporary main, a 2 in. pipe, was put in a street where the fill had been pumped out of the bay. The salt water corroded it in about eight months.

Electrolysis was the cause of another leak in Alameda, current coming from the street car rail had eaten our service pipes across the track for two blocks. We renewed them and bonded the rails on both sides with heavy copper wire and that avoided any further trouble.

In this connection I would like to emphasize the advisability of making surveys from time to time in order to detect tramp current on street mains or services and remedy the trouble before enough action has taken place to cause leakage, also service and meter men should be instructed to report at once any evidence of electric current which they may detect in their daily work.

DISCUSSION OF PAPERS AT EIGHTEENTH ANNUAL CONVENTION PACIFIC COAST GAS ASSOCIATION.

"Gas Leakage."

Mr. Dorr: Mr. President, my experience has been very much along the same line. The only trouble with electrolysis has been over in Alhambra, and up where the railroad company had a rail running parallel to the pipe line. The greatest trouble we have with leakage is caused by the trucks. I do not know how it is in other cities, but they have these large trucks—traction engines, here, and put these big plows behind them and tear up everything and in that way we have trouble. Whenever they begin to work on a street we have somebody from the gas company right there. Otherwise we would not have service there at all. Frequently they plow them up. I remember two or three instances where they plowed up the services and set fire to them. Otherwise my experience has been just the same as Mr. Kirk's.

President: Mr. Morgan, have you any remarks to make?

Mr. Morgon: The paper seemed to me to cover the ground in a very comprehensive way. Of course, all companies have leakages from some causes. In San Francisco we have arranged to have the Board of Public Works notify us when a contractor is awarded a contract for street improvement, and when we find our services are not deep enough to escape the plow—if they are not, we lower them.

I noticed Mr. Kirk said he used wooden blocking in laying mains. From our experience I think this is a mistake. In overhauling pipe we found some pipes that have been laid on blocks and the blocks had entirely rotted away, so I think it is better to tamp the pipe as solidly as possible with earth, because earth will stay there and the blocking won't. I find that most leaks in San Francisco are caused by the rotting away of the service pipes. Cast iron pipes last sometimes only five or six years. In case of electrolysis some service pipes would only last about six months.

Mr. Britton: I am a great believer in the theory that it is better to surround a man during his lifetime with honor, than it is to sprinkle flowers on his grave afterward. Mr. Kirk, the author of this paper, and I, entered the employ of the Oakland company about the same time; I think I possibly preceded him a week. At the time he took charge of the street work in Oakland, we had approximately 21 miles of street mains, and about 600 services. From that day, thirty-six years ago, every foot of pipe laid in Oakland has been laid under his direction, and now there are approximately 60,000 services and over 400 miles of mains. As an index of the kind of work he has to do, I am told by Mr. Leach, that he has traveled, since about the middle of June, over 4000 miles in his automobile in that territory alone, taking care of street mains and installation of services. It is the old man in the line of business who has grown up with it that makes the most effective workman, and "like master like man" you will find the men under him doing just exactly what he wants them to.

He has brought out a number of items in his talk that are interesting, and when he spoke of the cast iron main under the canal across Park street, it brought to my memory the first high-pressure installation in Oakland, where we used 8 in. iron mains that had been in the ground possibly, at that time, ten or fifteen years, and without going over the joints or inspecting it in any way we used it for high-pressure, supplying the north part of the city and subjected that main to 20 lb. pressure. There never was a leak in that cast iron main—and though it was parallelling a street railway it was never affected by electrolysis. That pipe was underneath the estuary crossed by the Park street bridge—that pipe was cast iron and so was the entire main a cast iron pipe running from the corner of Washington and First streets, about 7 miles of 8 in. pipe running over to the Alameda side, and 6 in. from there to the holder, and that was subjected, at times, to a pressure of 40 lb. and yet that pipe never leaked—never showed the least signs of leakage. There is a very serious doubt in my mind whether we are not losing confidence in cast iron pipe unnecessarily. It certainly is cheaper installation; it certainly is not subject to the soil action like steel pipe or wrought iron.

The gentleman was just speaking on the wooden blocking rotting under the pipe. I think that depends entirely upon the soil action. There are certain soils in which wood even when creosoted, will deteriorate and rot, but the majority of soils will not affect wood. I have never seen blocking that was affected by soil, but I can imagine conditions of soils in San Francisco that would affect it. I imagine adobe soil might have an effect in rotting, but I do not think that bears out Mr. Kirk's theory. The matter of gas leakage, it seems to me, as to street mains, can be avoided if the street mains are laid with care. In my opinion the large amount of leakage some gas companies suffer is due primarily to the fault at the works. The second error is in the meters failing to register. That is an enormous factor. You take a company having anything over forty or fifty thousand meters in a city and in my judgment the sum total of the gas used and not registered will account for a fair proportion of the leakage; the other is due more often than not, to defects in wrought iron or steel services.

Mr. Dorr: I find that in the cast iron mains the greatest leakage is due to the caulking and I have always found, if you take the majority of men, they have the idea it is the lead that make tight joints. I have always held it was a yarn. You take the majority of men, men that have been caulking for years—they will take a little yarn and put it in the joint,

and put another little piece in and then pour the lead in and think that will hold it. I say that is the least important; the yarning is the most important. If joints are properly yarned they will have very little trouble. We have something like five or six miles of 8 in. pipe, and possibly a mile and a half or two miles of 10 in. that have carried from 40 to 45 lb. pressure. This pipe was laid through sandy soil, and we took particular care in laying this pipe. In the first place were very particular to yarn it properly, and we got the best hemp so the joints were all well yarned, and I don't remember a single instance—it has been some eight or nine years since that line has been laid—I don't remember a single instance where we had a leak.

Mr. L. P. Lowe: Have you tried lead wool?

Mr. Door: I have tried lead wool, but never had satisfaction.

Mr. Martin: In regard to the making of joints tight by yarning. I would like to say that in Inglewood we have had some experience in caulking joints where no yarn was used. We used the Converse Lock Joint Pipe. While the joints will not come together in such a way as to be absolutely tight, still the lead will make them so, and no yarn at all is used. The iron is brought to the iron tight, and close, and then the lead is put in and thoroughly caulked.

WRINKLES READ BEFORE THE 18TH CONVENTION OF THE PACIFIC COAST GAS ASSOCIATION.

BY WM. SCHADE, WRINKLE EDITOR.

Wrinkle No. 1. Meter Cocks.

BY W. J. DORR.

In changing the method of connecting meters from the use of lead pipe to solid iron connections, we have accumulated a large number of ¾-in. meter cocks of the type used with lead connections, and to utilize these cocks we have hit upon the following plan:

Cut off about ½ in. of the tapered end of the meter cock and cut a ¾-in. pipe thread on the cock, then take a ¾-in. malleable coupling, tin both the threads on the cock and in the coupling by immersing in a melting pot of hot solder, and when both are well tinned, screw them together in a vise while still hot. This makes a solid joint, and the coupling can not be removed from the cock except by reheating the same. If desired, a brass coupling can be used instead of the malleable iron one.

Wrinkle No. 2. Treatment of Iron Oxide.

BY JAMES E. KELLY.

The treatment of iron oxide, commonly used at the present time in gas purification, by the introduction of steam in small quantities at the top of the box, through the cover when reviving them, has been a great assistance to us in Stockton. This process was put in operation in the early spring of the current year, when it appeared that the purification capacity was not sufficient to meet the demands of the gas manufactured.

The plant is equipped with a set of four boxes 14 x 14 x 3, connected to a center-seal valve, and a 4-in. connection is made to each box under the trays and connected to a No. 1 Sturtevant fan for reviving. The oxide was prepared according to a formula in general use on this coast. It was our custom to raise the covers and revivify at least three boxes daily. Since we began using steam we have not raised a box for four months, and the boxes are still in good working condition at the present time

The small amount of condensation which takes place serves to maintain the oxide in a moistened condition, naturally aiding its activity, and the results realized by us from this comparatively simple operation has been most satisfactory.

This wrinkle is not mentioned to the association as a matter of particularly new practice, having been in more or less general use for several years past. We feel, however, that some of the members may have lost sight of this application of a well known principle, and we hope that it may be worthy of their attention and the means of relieving them, as it has relieved us, from some of the ills to which the "gas-house terrier" is at all times heir.

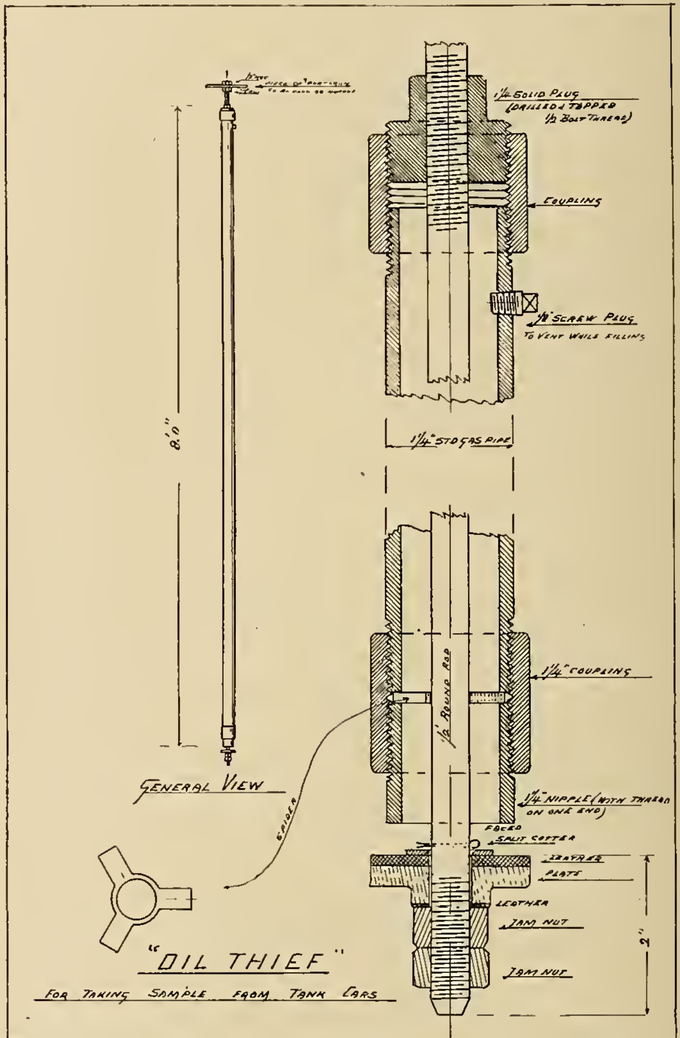
Wrinkle No. 3. Oil Thief.

BY L. P. LOWE.

The enclosed sketch shows a simple form of a device known as an "oil thief" used for the purpose of taking a uniform sample of oil from tank cars, the operation thereof being as follows:

Open the valve at bottom of "thief" by screwing down on interior rod. Remove ⅛-in. vent plug at top of "thief." Lower "thief" through opening in dome of car, allowing it to drop slowly in order to preserve uniform level of oil in car and in "thief" during process of lowering.

When "thief" has reached bottom of car and is full close valve by screwing upward on interior rod and insert vent plug,

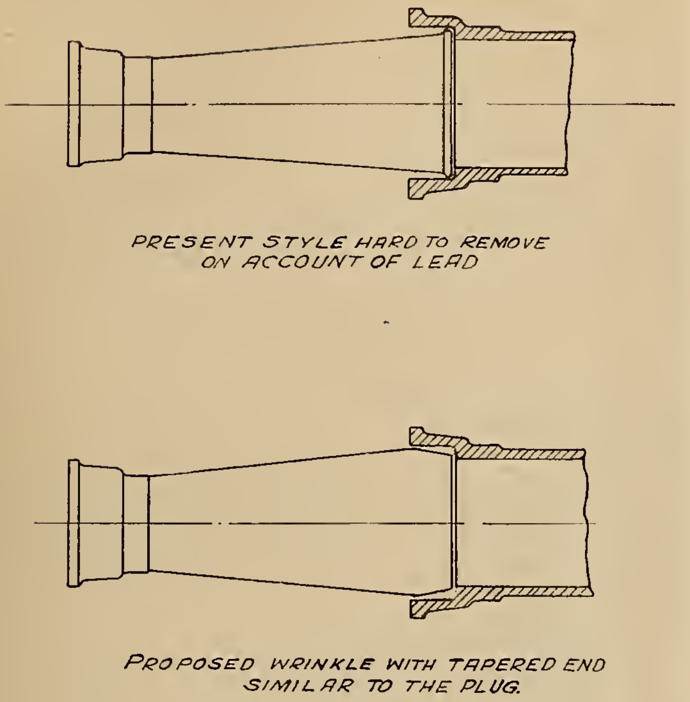


then withdraw "thief" and which by reason of being closed can be handled in a horizontal position without spilling.

As the regulations of oil companies provide that samples of oil shall not be taken from cars at a lower distance than 2 in. from the bottom, this instrument is designed so that when open the lowermost thereof will rest on bottom of car, leaving the necessary 2 in. space between bottom of car and bottom of "thief" inlet. This device is simple and inexpensive and can be made from materials usually on hand in any gas works.

Wrinkle No. 4. Cast Iron Pipe Reducer.

I would suggest as a wrinkle that cast iron pipe reducers be made with spigot end tapered after the manner of the plugs that are to be knocked out, so that the reducers can be received in the bell of tee or cross without having to remove the lead, but simply to force in a caulk, thereby saving time and annoyance. Also the ease at some future time with which the reducer can be removed in case a larger diameter main is required, as it is rather a hard job to remove a leaded end from a bell when



Cast Iron Pipe Reducer.

you are in a hurry. This has been found satisfactory and the joints have been subjected to heavy pressure without detriment. Plugs are removed with a clamp and screws jacked against the bell.

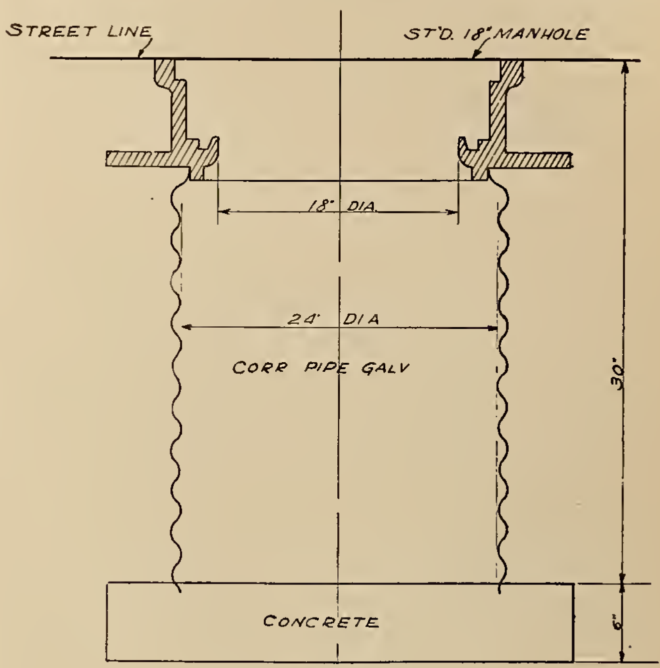
Wrinkle No. 5. Interchangeable Service Cocks.

BY SHERWOOD GROVER.

The illustration shows an interchangeable service cock wrench for use in emergencies for various sizes of service cocks. The

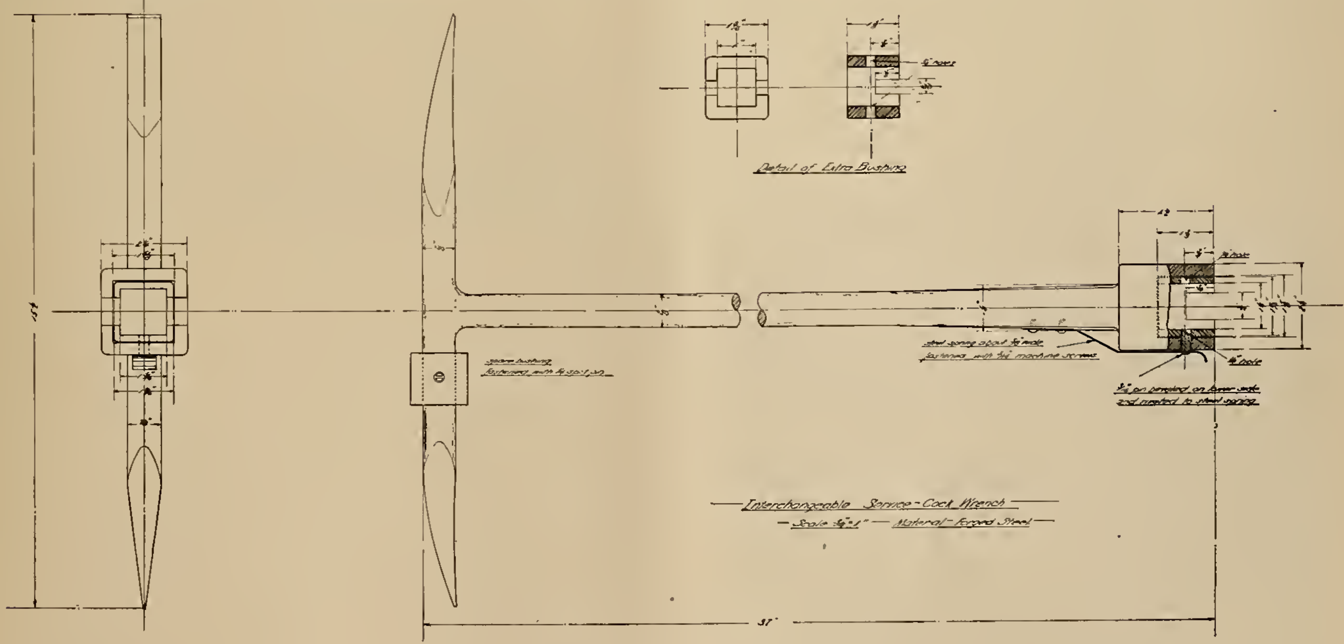
Wrinkle No. 6. Service Manholes.

The illustration shows a service manhole which we have found inexpensive to construct, very much cheaper than brick or concrete, and which meets all requirements. Tests made indicate that Toncan metal will last a great many years. I do not know,



Service Manhole.

however, that it is being used except for culverts. The manhole is used by this company in improved streets at intersections where valves are installed.



Interchangeable Service Cock Wrench.

print is merely of a type, and the principle may be changed, of course, to suit conditions. The tool shown is intended to use for either flat head or tee head cocks of three different sizes. The wrench itself taking one size and two extra bushings, one of which is carried in place, and the other attached to the handle with split pin as shown. The bushings are held in place by a little pin attached to a spring. The tool was devised by the foreman of the Pacific Gas & Electric Co's. meter department at Oakland, Mr. J. J. Mulgrew.

Wrinkle No. 7. Cleaning Stand Pipes.

BY D. J. YOUNG.

Our large generators have 30-in. outlet pipes. To clean the stand pipes is quite a task and was made more difficult by the fact that a 30-in. cast iron flange had to be moved each time in order to get access to the pipe. We relieved this part of the trouble by using a 12-in. "hat flange" on the 30-in. flange. This is simply a 12-in. nozzle in the center of the 30-in. flange, and is closed by a 12-in. blind flange. This is of a size which one man

can easily handle, and allows plenty of room for cleaning, but does not permit the escape of so much heat, resulting in the work being done more quickly and easily than heretofore.

Wrinkle No. 8.

BY S. C. LOWE.

A great many times the complaint department of the gas company is called upon to fix the burner in a gas range and I have found that a simple remedy for fixing the upper burner is to ignite the gas in the mixer and let the burner become heated. After which it is removed and all the grease will have been burned off of the inside of the casting. This is a simple and effective means of cleaning a gas range burner.

I also submit a wrinkle to be used in connection with installing a drip on a street main. It sometimes happens that water accumulates in low spots and it is necessary to put in a drip after the original installation of the pipe. On a high pressure line it is difficult to tap the main on the bottom so the best method is to take two saddles and fasten them on the pipe, one saddle on the top and one on the bottom. The bottom saddle can be put on without the stop-cock and in its place use a street ell to run off to the drip. After this connection is made the pipe can be drilled from the top right through the bottom. This makes a convenient and easy method of putting in a drip, and while the cost is slightly more it is more than overcome by the saving on drilling of hole on the bottom.

It is more or less disagreeable to have a boiler blow off around a gas plant on account of the dirt and noise, and a very effectual means of deadening the sound, together with its cleansing effect, is to connect up all of the gas scrubbers with the boiler blow off. By this means the scrubbers can be kept thoroughly clean and flushed out daily with the water that is usually blown off into a sump hole. I also find that if the blow off line is connected into connecting lines between scrubbers that it is an effectual way of keeping all of the pipes clear and does away with the danger of gas works stoppages.

THE NEW HOME OF THE DENVER GAS & ELECTRIC COMPANY.

The newly completed building of the Denver Gas & Electric Company, at Denver, Colo., is said to be the best lighted building in the world. The exterior illumination as shown in the accompanying illustration, taken at the time of the formal opening on November

Night Illumination of Denver Gas and Electric Company's Building.

12, 1910, is at once artistic and brilliant, 13,000 lamps being used and 250 miles of wire being required. Its initial lighting was made a gala night in Denver.

A SUGGESTED COMMUTATORLESS DIRECT CURRENT GENERATOR.

BY E. GROTE AND F. DAVIDSON.[1]

This paper describes the construction of a machine designed to generate high tension direct current without the aid of a commutator. The construction is based on the theory of putting a conductor into motion through a uniform magnetic field, the result of which is to set up an e.m.f. This e.m.f. can be increased if several conductors are employed.

Thus, if x = e.m.f. of one conductor, the total e.m.f. = x $\times$ number of conductors in series.

It is well known in the law of induction that the following axioms hold good, viz., that no currents are set up:

1st. In any point of a non-magnetic field.

2d. In a permanent magnetic field where matter passes through the field parallel to the lines of force.

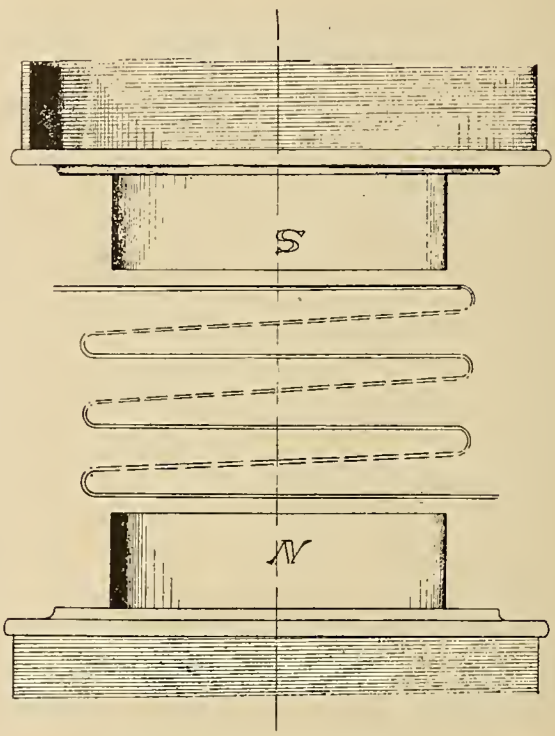


Fig. 1.

3d. In any part of a rigid body placed in a homogeneous magnetic field.

It will be granted that if a conductor is moved in a magnetic field so that it cuts the lines of force, an electric current is generated; also an e.m.f. is set up which is in direct proportion to the number of lines of force cut. It is also known that the exit of the lines of force from iron into the atmosphere is always at right angles to the face.

Both the exit and entrance being at this angle, it is quite feasible that a non-alternating field can be constructed. We can now, therefore, generate an e.m.f. which will always be in one direction. The formula resulting from a conductor moved in a homogeneous field with a rotary motion is $\phi = \phi$ max $\times$ cos d $= \phi \times \cos(\omega t)$.

Where ω = Angular Speed.

T = Time.

[1]Transactions of the South African Institute of Electrical Engineers.

$\therefore$ e.m.f. is $E^1 = \phi \max \times \omega \times \sin(\omega t)$.

Referring to Fig. 1, and supposing the conductors shown are moving through the field, each of the conductors are generating a current in the same direction.

Now, if we can connect the ends of each conductor in the manner shown by the dotted lines, and bring these connections either through a non-magnetic field or exactly parallel to the lines of the field, we have achieved the desired result. Fig. 2 shows how this is effected.

In order to construct a magnetic field, such as is

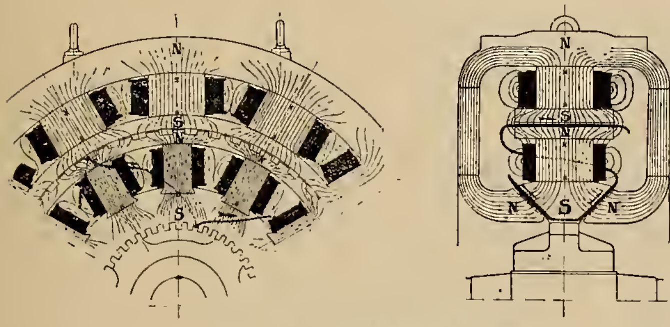


Fig. 2. Characteristics of Magnetic Fields in Armature Construction.

required in machines for generating a direct e.m.f., it is necessary to connect the magnetic lines of force between the opposite poles.

In the case of an ordinary generator such connection is made through the frame of the stator and the iron of the rotor. The lines of force pass through the air-gap and the armature, cutting the conductors situated round the periphery of the rotor, thereby an e.m.f. is generated as soon as the rotor is set into motion. This e.m.f. changes from positive to negative and vice versa, as the polarity changes on account of the motion of the rotor, thereby an alternating current is set up which, in the case of a direct current machine, is commutated and thus made continuous.

In order to set up a continuous current in the armature without commutation it is necessary to move the conductor in a field of constant polarity.

This principle has been known for a considerable period, but the application of it has met with considerable difficulties, which were greater in the construction of the armature and armature coils than in the formation of the magnetic field itself. Therefore, a machine which directly generates continuous current in the coils of the armature has been regarded hitherto as outside the bounds of practical construction.

Only in recent years, Mr. Noeggerath, an American engineer, succeeded in constructing a machine capable of generating a continuous current at a pressure of 600 volts, without a commutator. This machine has one fault, which is, that the extremely high rotary speed of 125 metres per second has to be attained before attaining the above voltage in a comparatively short conductor. Beside, on this machine the coils on the armature cannot be wound in the usual way, because a reverse e.m.f. would be set up in the return part of the coils. The problem of the series connections is solved by connecting the end of each conductor to a slip-ring, and the return wires being brought back outside the influence of the fields of the machine. It therefore follows that two slip-rings are necessary for each conductor in the armature, the addition of which made the rotor three or four times longer than it would otherwise have been. The result is that the practical use of this machine can only be very limited.

In this paper we are endeavoring to describe an electrical machine capable of generating continuous currents at high tensions in the armature, without the aid of commutation, and with only two or four slip-rings; and we believe we have found a way to construct such a machine.

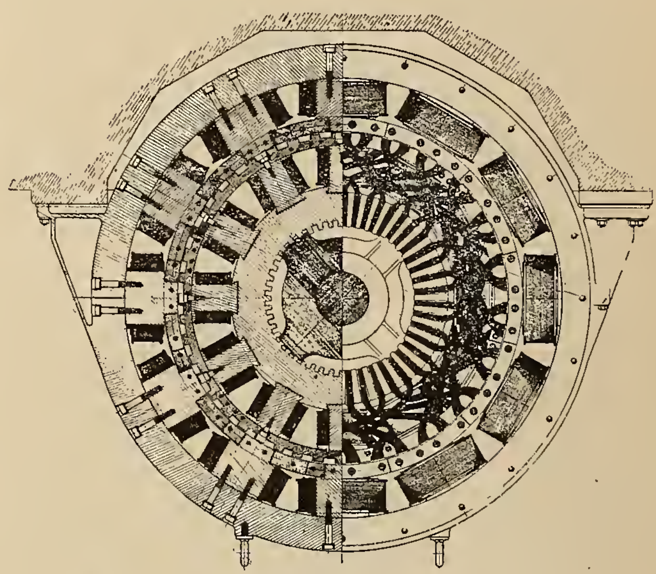


Fig. 3. Cross Section Through Stator and Rotor.

Fig. 3 shows the arrangement of the field windings and armature windings, and the characteristic points of the field in the longitudinal and diagonal section of the machine.

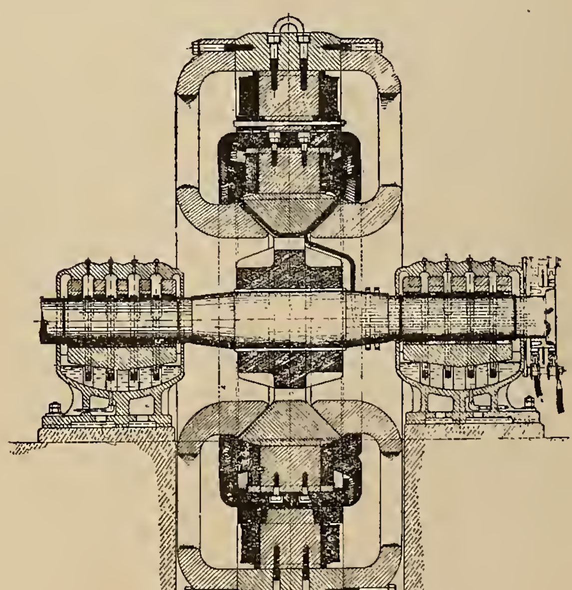


Fig. 3. Longitudinal Section Showing Armature Windings and Stator Field Coils.

The main point of difference in this machine and an ordinary generator is that the field does not extend as in the usual case from the north pole through the iron core of the armature to the south pole and thence

through the frame back to the north pole; but the direction of the lines of force, on the contrary, is through the axis of the armature, starting from the stator field coil and returning through the curved limbs, as shown in Fig. 3.

By this means, the armature windings will be cut twice by the main field, namely, once in the upper air gap and once in the lower air gap, both in one and the same direction.

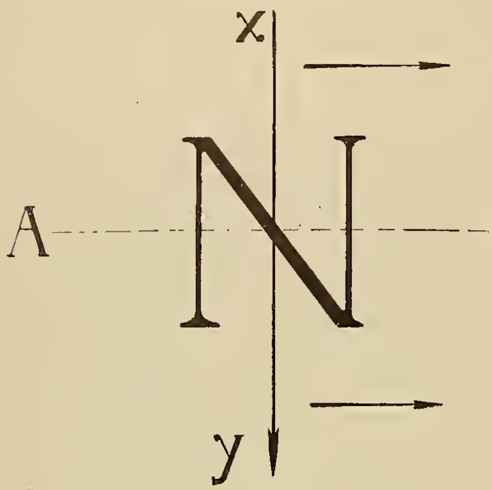


Fig. 4.

Referring to Fig. 4, if

W = the plane of the N. P. of a magnet, and

AB = a conductor moved at right angles over the pole and in a rectangular direction to its length, the current thus generated will flow in the direction shown.

In this instance, the direction of movement is from A to B, and the direction of current from X to Y.

By simply connecting the conductors in the lower part of the armature to those in the upper part, the currents induced in them would neutralize one another.

A second task therefore presents itself, namely, to loop up the two conductors in such a manner that the currents induced in them shall not be in opposition but sympathetic, and without setting up any back current in the conductor which is used to loop them up, otherwise the construction of such a machine would be impossible. As has been shown, it is possible to form a non-alternating field, in which a number of conductors can be moved in such a way as to generate a continuous current. An armature brought into such a field, and fitted with conductors specially constructed for the purpose, would allow of such a current being generated to any desired amperage or voltage, according to the connection of each individual conductor.

This may be done, provided the conductors used for looping are not situated in the same field as the main conductors which they are connecting.

The original idea was to employ the permeating co-efficient forces of air and iron, in order to make the loop connections in a non-magnetic field or in a field of opposite polarity.

The permeating co-efficiency of air (U) = 1, and approximately the permeating co-efficiency of iron (u) = 6.

Now, if the armature is so constructed that gaps are left at certain intervals at the circumference through which the loop connection is taken, a back electro-motive force is set up, which would approximately be u — u₁. In order to obtain fairly satisfactory results, the mass of iron in the armature would have to be very large. Also other drawbacks, such as eddy currents, resistance of coils, etc., etc., would greatly reduce the efficiency of the machine. It therefore follows that the above theory, although a partial solution of the problem, cannot be regarded as a really efficient one. Suppose, however, the construction of the armature is the same, but the gaps are widened sufficiently to enable a coil to be inserted; in other words, to enable electro-magnets to be inserted in the rotor, the magnetic field would be considerably changed, inasmuch that in both the upper and lower parts of the armature a magnetic field would be set up.

Besides this, the stator field will attract the rotor field and vice versa. If the iron is not super-saturated, and the air-gap between the stator and rotor is kept small, the lines of force from the field coils will be attracted by the magnetic fields in the rotor.

By these means the great majority of the lines of force will travel through the rotor magnet cores, leaving only about 10 to 15 per cent of the total lines outside. The loop connections of the armature conductors are therefore taken through this weak part of the field, and consequently, the reverse e.m.f. set up in them is proportionately small.

The formula for the strength of the e.m.f induced in the main conductor is

$dE = Hv \times \sin \alpha \times \sin \chi \times dl$ where dl = length of conductor which is moved at a speed V in a magnetic field of a strength H and where α is the angle formed by the conductor and the lines of force and χ is the angle resulting from the rotary movement to the lines of force. The total strength of the e.m.f. will be $E = \int Hv \times \sin \alpha \times \sin \chi \times dl$. E is the largest value when α is 90° ∴ if χ is as small as possible, and α as large as possible, the reverse e.m.f. generated in the loop connections will be an almost negligible quantity.

Eddy currents and hysteresis are now avoided. As there are no alternating fields in either the rotor or the stator we can use solid iron for both these parts, which simplifies the construction of the machine considerable.

The calculation for efficiency is now very much the same as for any ordinary machine. The stator field will also show a similar appearance as is usually the case, namely, it will set up a distortion in the direction in which the armature is rotating.

The main flux of the lines of force in this machine is separate for each individual field. This flux will originate from the two principal poles only, that is to say, that all the cores projecting from the stator are of one polarity, and all the armature cores will be of the opposite polarity. All the positive polarities and all the negative polarities run parallel with each other. Also the poles in the main field are arranged so that the armature windings are cut in one and the same direction as long as the rotation remains the same.

From the foregoing we have shown that continuous currents can be generated, the e.m.f. of which can be made to any desired voltage, merely depending on the way in which the armature conductors are connected up.

If a diagram of the continuous currents of such a machine is taken, it will show a line of waves. This is explained by the fact that the torque in the iron of the armature is opposed to the flux of the lines of force in the main field.

Further a torque will be set up against the direction of rotation and in the rotor itself, in such a way that the first half of the flux of the lines of force will cut the armature windings at almost a right angle. The other half of the flux of the lines of force in front of the first half will cut the armature windings at a considerably more acute angle.

Now, the e.m.f. induced in a conductor depends upon the angle at which the lines cut, and, therefore, the first half of the flux above-described will generate a higher e.m.f. in the coils than the second half.

This will naturally set up pulsations, but these pulsations can be considerably diminished by making the fields as uniform as possible, namely, by using the best soft iron of uniform quality for the polar rings, with as many poles as possible, both in the stator and rotor.

The main purpose of the rotor electro-magnetic coils, which are in shunt to the main armature coils, is as follows:

1st. To attract the flux of the lines of the main field as much as possible from the zone, where the effective conductors of the armature windings are looped together.

2d. To generate a rotating field in opposition to the lines of force in the main field in that portion of the machine where the loop connections are taken through. This rotating field will, of course, be only a comparatively weak one.

3d. To strengthen the main field and to offer less resistance to the lines of force of the main field, thereby diminishing the leakage lines of force and any disadvantages which might be experienced from them.

For high tension generation, it would probably be found an advantage to excite the fields by separate excitation, in which case the machine would have to be equipped with four slip-rings. For voltages under 500 it could be shunt wound in the ordinary manner, and would only require two slip-rings in that case.

A new method for producing high-tension discharges was described by Prof. E. Wilson and W. H. Wilson at a recent meeting of the Physical Society of London. Energy is taken from an alternating or continuous-current source and stored in a magnetic field by an inductance; it is then permitted to surge into a condenser which forms with the inductance a low-frequency oscillating circuit. When the energy is stored in the condenser, the latter is mechanically bridged across the primary winding of a spark-coil, with which it forms a high-frequency oscillatory circuit. The energy is then transmitted by the secondary winding of the spark-coil to the work circuit in a well-known manner. The method therefore involves the use of an inductance, a condenser, a spark-coil and a special contact-making device.

STANDARD TESTS FOR INSULATING MATERIALS.

The American Society for Testing Materials has appointed a committee on Standard Tests of Insulating Materials, known as Committee D-9; Mr. C. E. Skinner, of the Westinghouse Electric & Mfg. Co., being chairman. At the present time the testing of insulating materials is in a chaotic state, due to lack of standard methods and standard tests. Each producer and each consumer has his own tests. But these almost invariably differ from those used by others. There are certain fundamental tests which are required in all classes of insulating materials; it is thought that the standardization of these tests will be of direct benefit to producer, consumer and independent testing laboratory. The producer can submit results of tests, which can be directly interpreted by the consumer, and to a large measure avoid the necessity for submitting samples and having tests made by each individual consumer. The consumer will be able to judge materials closely enough to know whether he will be obliged to proceed with further laboratory or commercial tests. The facilities of the independent laboratories will become directly available for making tests which can be used by both consumer and producer.

The committee desires to secure from manufacturers, users and testing laboratories information in detail as to the methods pursued in making the regulation tests. With this information at hand, it is hoped that the more important of these tests may be standardized to the benefit of all concerned. The list of tests given below is intended to cover all the important properties of the whole line of insulating materials. No one material, of course, would be subject to all these tests. Partial replies will be welcome, even if they relate to but one material or test.

The information desired is that pertaining to testing methods, not to the insulating materials themselves. In order that the work of the committee may be satisfactorily accomplished, it is necessary that all the details be given, not only of the methods of testing, but also the manner of preparing samples. For instance, in preparing samples of insulating cloth, the kind of cloth used is important, how it is prepared for treatment, how the insulating material is applied to the cloth, at what temperature and density it is applied, etc. The committee wishes to have opinions as to the advantages derived from the results of tests, also what tests are considered the most important, not only of those in the list, but also of any others that may be made, with reasons for such opinion.

Since the deterioration of insulating materials with time is an important matter, it would be desirable to be able to predict the life of the material in service from the fundamental tests on the new material, if this can be done. In some cases, the purpose for which the material is to be used, or its final form, has considerable bearing on the testing methods employed. In such cases, this fact should be indicated. While the plan as above outlined will involve considerable labor for all concerned, it is believed that the results will justify the expenditure, and universal co-operation is therefore earnestly solicited. Replies can be addressed to H. B. Brooks, Bureau of Standards, Washington, D. C.

RATIONAL CONSERVATION.

In the course of a recent address as reprinted in the Mining and Scientific Press, C. W. Hayes said that like most other articles of faith, conservation means many widely diverse things to different men. A clear definition of the term, a formulation of creed, is therefore a necessary preliminary to the discussion. Disregarding the views of the extremists and visionaries we may define conservation as utilization with a maximum efficiency and a minimum waste. Please note that I lay special stress upon utilization, for I regard it as an essential feature of any form of practicable conservation. To conserve resources for future generations at a serious sacrifice of the interests of the present is not only unwise, but is wholly impracticable and visionary. To be effective, therefore, conservation measures must rest upon an economic basis; to secure the adherence of an interested party they must appeal to his business sense as offering distinct material advantage. Thus the arguments for conservative forest management of privately owned forests were absolutely without effect until it was demonstrated that such management offered larger profits than the practice in use. Likewise it is useless to urge a coal operator to mine out all the coal in a bed if by so doing he runs his mine at a loss. Only the inducement of economic advantage, of increased profits, will be generally effective.

There appears to be an unfortunate confusion in the minds of certain advocates of conservation. They have apparently confused conservation of natural resources with destruction of the trusts, and the mixture has resulted in pure demagoguery. Unquestionably both subjects are highly important, but they have no necessary connection, unless indeed they are antagonistic. The natural resources will not be conserved by destroying the trusts, nor will the trusts be controlled by checking the waste of natural resources. Anyone who has studied conditions attending the development of mineral deposits must have been impressed by the fact that those deposits held by large companies are being developed and utilized with a view to prevention of waste, in accordance with the principles of conservation, to a much greater extent than are the deposits held by small companies or by individuals. The explanation is purely economic. The large company can introduce at a profit methods for preventing waste which would be ruinously expensive to the small operator, and furthermore the soulless trust is immortal and must provide for its continued existence far beyond the ordinary lifetime of the individual. Hence the logical conservator of our natural resources is the trust. I am aware that this is rank heresy in certain quarters, and that my statement is liable to be misunderstood and distorted, but the sooner we recognize clearly the antagonism between conservation and destruction of the trusts, the sooner we shall be in a position to solve the problem wisely and fairly.

It is obvious that the term 'natural resources' covers a wide field and that from the viewpoint of conservation they admit of classification into a number of widely separated groups. The type of the first group is water-power, which is conserved only by utilization, and is best conserved when it is most fully developed and used. In this group are wind-power and the radient energy of the sun. Since water-power cannot be conserved by hoarding, its early and complete utilization in the most efficient manner possible is clearly the end to be sought. The second group includes forests and soils which are renewed under favorable conditions, though slowly, and to yield the largest benefits must be used continuously, but are liable to serious depreciation and waste through improper use. Here the problem is obviously to balance the use against the renewal so that the resources suffer no permanent depreciation. The third group includes minerals which once used are never renewed, but are gone forever. A further subdivision of the useful minerals is necessary into two classes, inexhaustible and exhaustible. Of these the first includes those minerals which occur in nature so abundantly and so widely distributed that no conceivable use will materially diminish the visible supply; such are salt, limestone, clay, sand, building stone, and in general minerals used as structural materials. The second class, the exhaustible minerals, includes those which, although in many cases they occur in very large quantities, nevertheless are definitely limited in distribution and amount; such as the fuels—gas, oil, coal, and lignite; the metalliferous ores, sulphur, and phosphate.

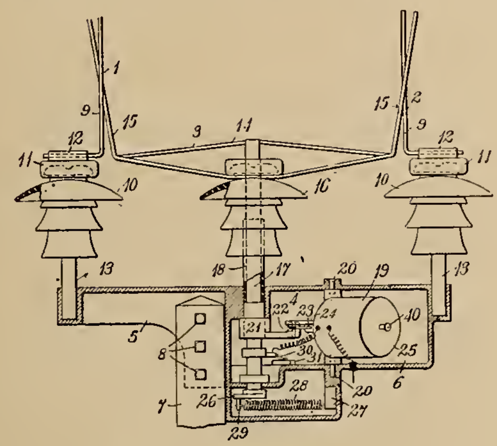
It is this latter class, exhaustible minerals, with which the problems of conservation are chiefly concerned. Here it is necessary to weigh present demands against future needs, and to devise methods of utilization which shall neither sacrifice the interests of the present nor entail unnecessary hardship on future generations. This can be accomplished in general, by utilizing the minerals (1) for the purpose for which they are most valuable, (2) in the manner that will secure the most efficient results, and (3) in the locality where the greatest economics can be effected.

WIRELESS COMMUNICATION WITH MAGDALEN ISLANDS.

The Magdalen Islands are the most northerly of the North Atlantic coast ports from each early information as to the danger to navigation from floating ice can be obtained. In winters, when the cable connecting the mainland with this island group fails to work, navigators are often unable to form a correct judgment of ice conditions in the North. The Marconi Company will this fall erect a wireless station on the Magdalens to be ready for service the coming winter. Three men are to be in charge during the winter months and two in summer. This assures constant communication with Charlottetown and the other ports of the maritime provinces. The Point Amour and Belle Isle stations are to be kept open the whole of the coming season. By means of the information to be furnished from all of these points it will be possible to forecast hereafter with some accuracy the probable time of the resumption of navigation from and to Canadian North Atlantic coast ports, as also the possible dangers to the trans-Atlantic service in the early summer months from huge masses of ice.

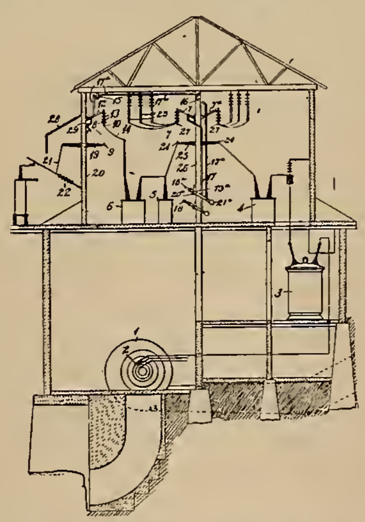
PATENTS

975,418. Electric Switching Device. Ford W. Harris, Wilkinsburg, Pa., assignor, by mesne assignments, to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. In a switching device, the combination with a supporting frame, pins projecting upwardly from the ends thereof and provided with insulators, and stationary contact members projecting upwardly from said insulators, of a rotatable



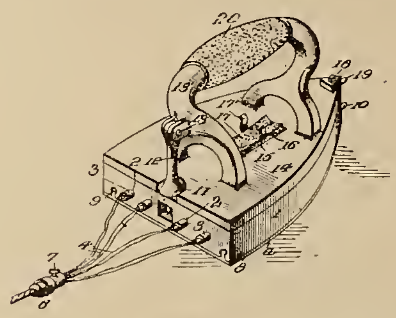
shaft located between the stationary contact members, a bridging member secured to the rotatable shaft and having upwardly projecting contact arms, a spring tending to hold the bridging member at one end of a ninety degree arc of rotation, a lever arm projecting laterally from said shaft, an electromagnet rotatably mounted with its axis parallel to that of the shaft and having a movable contact member connected to the laterally projecting lever arm.

975,422. Disconnecting-Switch for High-Potential Circuits. Stephen Q. Hayes, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A disconnecting switch comprising a horizontally disposed insulating bushing



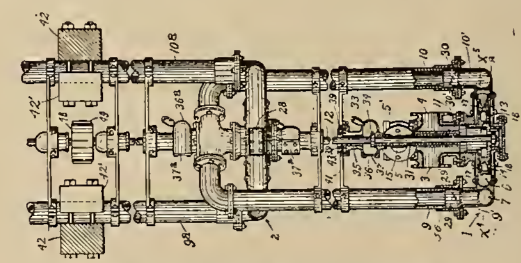
having a contact terminal at one end, a lever pivotally supported above the bushing and a movable contact terminal freely suspended from the outer end of the lever, insulated therefrom and adapted to move vertically into and out of engagement with the stationary contact terminal.

975,936. Combined Electric Iron and Stove. Burton R. Charles, Portland, Ore. In a combined iron and stove, the combination with a supporting base, a handle therefore, having a flange which normally rests on the base whereby the base and handle form an iron, means whereby the handle will serve as a support when the supporting base is inverted and



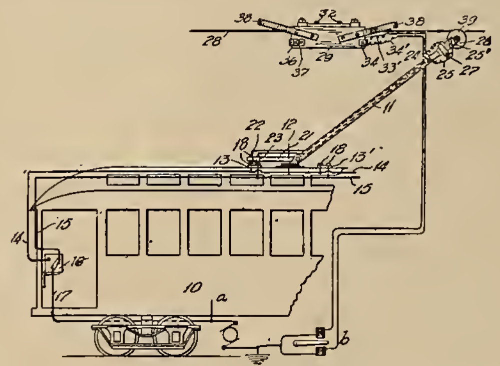
used as a stove and the flange on the handle will serve as a support for said handle when the device is used as a stove and means for electrically heating the base when used as an iron or stove.

975,623. Centrifugal Pumping Apparatus. David W. Jones and Earl W. Koppe, Los Angeles, Cal. In a centrifugal pump, a runner having a plurality of discharge channels, said channels having ports extending outwardly through the top of the



runner; and a regulating ring mounted on said runner revolubly with relation thereto, said ring having ports which may be brought into or out of register with said ports in the runner to partly or wholly open or close the same.

975,585. Electric-Circuit Controller for Railway-Switches. Guy M. Thompson, Seattle, Wash., assignor to The G. M. Thompson Railway Switch Company, Seattle, Wash. A trolley actuated circuit closer, comprising in combination, an insulated housing supported by the trolley wire including spaced longitudinal side members, trolley guides secured to and



oppositely projected from either end of the housing, longitudinally arranged resilient contact plates secured to the side members of the housing and insulated from each other, a magnetic track switch, and a normally open electrical circuit including said plates and said track switch and adapted to be closed by the trolley frictionally engaging said plates.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.
DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Ozone

Electricity's latest contribution to household health and central station wealth is the ozonizer, which makes an artificial mountain air that excels the natural product. Ozone is a particularly active and energetic form of oxygen which may be produced by subjecting air to the stresses due to the radiations of electricity, heat or ultra-violet light. These resonant strains probably break up the molecule of oxygen into atoms which are free to unite with other oxygen molecules to form O_3, or ozone. Its characteristic clean odor may frequently be detected around electrical apparatus or in the high mountains where the ultra-violet rays are more abundant than at lower elevations where they are more completely absorbed by the atmosphere. It is so penetrating that one part of ozone in ten million parts of air can be detected by the sense of smell, a qualitative determination far more delicate than any chemical means yet devised. In such dilution it is strongly invigorating and exhilarating, but as it is further concentrated, it surfeits the sense and becomes disagreeable.

Its commercial production is usually accomplished by means of a silent electrical discharge through moving air. An alternating current is necessary and the best results are obtained with at least eight thousand volts and a low amperage to minimize the excess heat which destroys the ozone. Yields as high as 250 grams of ozone per kw.-hour have been obtained for industrial purposes, though the usual type of ventilating machine is calculated on the basis of ozonizing about 200 feet of air an hour per kw. in a 60-watt machine.

Its chief application has been in purifying water and in ventilating crowded rooms, the organic impurities in each case being oxidized and thus rendered harmless. Bad water and bad air are responsible for many bacterial diseases and also for much industrial inefficiency and as a corrective for those ills it provides the equivalent of a trip to the mountains.

Almost all odors can be instantly destroyed by this means, including those due to tobacco, cooking and sickness, as well as to tanneries, glue works and slaughter houses. However, it has not yet been able to rob the skunk of his terrors. Aside from its domestic use there are many technical purposes for which ozone is finding a constantly increasing field. Here concentration is the most important factor, one per cent by volume not being uncommon. For hospitals it is an ideal sterilizer and disinfector. It is also useful in treating insomnia and colds as well as certain skin diseases. As a food preservative it enjoys many advantages, and wines and liquors may be artificially aged by this means. Vegetable and animal oils may be bleached and deodorized at small expense and for laundry work its use is unsurpassed. It accelerates almost all of the beneficent organic processes of nature and counteracts many corruptive ones. If it meets with the same popular approval as its domestic predecessors the electric fan, electric iron, electric heating devices, vacuum cleaners and vibrators, the ozonizer will be a profitable load for many electric companies now bothered by a night peak.

PERSONALS.

A. M. Hunt returned last week from a trip to Portland on engineering business.

J. A. Herr, sales engineer with the Pacific Coast office of the Sprague Electric Company, is at Portland.

F. N. Jewett, general sales manager of the Wagner Electric Company, is visiting the San Francisco district office.

G. M. Gest, conduit engineer and contractor, with offices at New York, Cincinnati, Chicago and San Francisco, is visiting San Francisco.

W. H. P. Hill, manager of the Monterey County Gas & Electric Company of Monterey, Cal., recently spent several days at San Francisco.

Paul Shoup, who was recently elected vice-president of the Pacific Electric Railway Company, has been spending a few days at Los Angeles.

William H. Corbett, president and general manager of the Willamette Iron & Steel Works, of Portland, was a San Francisco visitor last week.

Géo. A. Kyle has resigned as vice-president of the Oregon Electric Railway, of Portland, Oregon, to engage in general engineering work at Portland.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, left during the past week for a tour of the San Joaquin Valley.

C. R. Gurtler, an engineer with J. G. White & Co., is installing two 12,000-kw. Curtis steam turbines for the Pacific Light & Power Company at Redondo.

Albert W. Hitchcock, plant inspector of the Western Electric houses of America, has arrived from Chicago, and is paying a visit to the San Francisco branch of the company.

R. D. Holabird of the Holabird-Reynolds Company, returned to San Francisco last week after spending several weeks in the Pacific Northwest in connection with his Seattle branch.

Ralph O'Neil recently resigned as engineer at the Techau Tavern and went to Taft, where he will act as consulting engineer for a large company operating in the oil fields of California.

H. A. Lardner, Pacific Coast manager for J. G. White & Co., recently returned to his San Francisco office after inspecting the work in progress for the San Joaquin Light & Power Company.

H. F. Dodge, division commercial superintendent of the Western Union Telegraph Company, has returned to San Francisco, after making an inspection trip through Southern California.

J. W. Gilkyson, division commercial superintendent of the Pacific Telephone & Telegraph Company's Southern Division, has returned to Los Angeles after spending a few days at San Francisco.

W. S. Berry, salesmanager of the Western Electric Company's San Francisco house, has returned from a trip to the New York office after attending the National Jobbers' Convention at Hot Springs, Va.

C. F. Mason, Commercial engineer of the Pacific Telephone & Telegraph Company, has been transferred from San Francisco to Los Angeles, where he will hold the position of District Commercial Superintendent.

Alvin G. Garratt, chief engineer and general sales manager of the Lombard Governor Company of Ashland, Mass., is at San Francisco, on a tour of the Coast and is making his headquarters with Pierson, Roeding & Co.

R. S. Buck, with Sanderson & Porter of New York, left last Sunday for a tour of the Pacific Northwest. At Victoria, B. C., he will join Wynn Meredith, the Pacific Coast manager for the firm, who has been superintending the installation of electrical machinery on the Jordan river for some time.

E. A. Beck, general superintendent of the Pacific Light & Power Company, who died at Los Angeles, November 10, 1910, was one of the best known electrical officials on the Pacific Coast. Twelve years ago he was connected with the construction of the lines of the San Gabriel Electric Company, which was the nucleus of the Pacific Light & Power Company.

TRADE NOTES.

Leo. J. Meyberg, formerly with Joseph Thieben, has located at 778 Mission street and will make a specialty of selling the Westinghouse "wire-type" tungsten lamps.

H. M. Estes, is carrying a $15,000 stock for the Star Expansion Bolt Company at 1010 Howard Street, San Francisco. This is the largest stock of this material on the Pacific Coast.

W. R. Greene, formerly with the Pacific States Electric Company, has charge of the Los Angeles office recently established by the American Electric Fuse Company at 459 East Third street, where a complete stock of this company's products is carried.

The General Electric Company reports the following steam turbine sale to the Lewiston & Clarkston Improvement Company, of Clarkston, Wash: One A. T. B. 4, 1563 k.v.a., 1800 r.p.m., 2300 v., Curtis steam turbine; also one C. C. 2, 25 kw., 3600 r.p.m., 125 v., shunt-wound Curtis turbine exciter.

Mr. F. G. Bolles, has resigned as commercial engineer of the Allis-Chalmers Co., to devote his entire attention to The Reliance Engineering & Equipment Co., 1417-19 Majestic Building, Milwaukee, in which he has an equal interest with C. A. Tupper and others. The company, which is taking on a number of additional exclusive agencies, will remove December 1st, to offices 415, 416 and 417 in the new Engineering Building, and considerably extend the scope of its operations.

Theo. F. Dredge, who is well known among the local electrical and steam engineers has opened an office as manufacturers' agent in the Monadnock Building, San Francisco. His principals include the Peterson Engineering Company of New York and Chicago, with a full line of oil pumps, filters and electrical supplies; the Hughson Steam Specialty Company of Chicago, manufacturer of valves and other steam specialties; Coffin Valve Company of Boston, Mass., specializing on sluice boxes and other material for irrigation and water-power companies; The Pittsburg Piping and Equipment Company of Pittsburg, Pa., fabricators of material for piping installations; and the United States Indestructible Gasket Company of New York, manufacturers of corrugated copper gaskets, etc.

The Pelton Water Wheel Company of San Francisco has secured a contract for an additional turbine for the municipal electric lighting plant at Brigham City, Utah, where a 500-h.p. Pelton impulse wheel, direct-connected to a Westinghouse generator is in operation. The new equipment includes a Pelton-Francis turbine operating under a head of 280 feet and developing 750-h.p. at 600 r.p.m., direct connected to a Westinghouse 3-phase 60-cycle generator. The specifications call for a 32-inch single discharge turbine of the spiral-case type, to be regulated by a Pelton oil-pressure governor. To assist in the regulation a heavy steel fly-wheel and a Pelton mechanically-operated valve will be used.

INDUSTRIAL

THE DEVELOPMENT OF PROTECTIVE DEVICES FOR HIGH TENSION CIRCUITS.

BY P. G. LANGLEY.

Electricity is most economically generated near a source of power, whether water, gas or coal. This fact has led to the development of many power sources, some of them remote from localities where there was a demand for power.

Locations close to centers of demand were first developed, and as the distances over which power was to be transmitted were small, few serious difficulties were encountered in the early days. As the nearer powers were developed, the increased demand created, necessitated the development of the more remote powers. Then arose engineering problems which have forced the development of apparatus to handle the high voltages necessary for economical transmission over long distances. One of the first long steps toward high voltage transmission was made about eight years ago, by the Washington Water Power Company. This company in order to supply power to the mines of Washington and Idaho, over transmission lines about 150 miles long, decided to use 60,000 volts. This development proved so successful that it was speedily followed by others and by rapid rises in voltage until 110,000 volts is now by no means unusual, and a rise to 140,000 volts has been proposed.

To meet these conditions it has been necessary to develop switching, measuring and protective equipments along radically new lines.

High voltage developments are necessarily expensive, and to effect economy large powers must be employed, so that in addition to taking care of high potential strains, it has been necessary to produce equipments capable of withstanding the explosive effect of interrupting the flow of large amounts of energy.

The first high voltage switches were designed along the lines of previous switches for lower voltages, the spacing and insulation being increased in proportion to the voltage. These consisted of contacts working in separate enclosing chambers, partly filled with oil, in which the arc was finally broken.

For each line wire, two breaks in series and consequently two chambers were employed, each pair of chambers being installed in an isolating, fire proof compartment.

The chambers were later improved by the addition of baffle plates and expansion chambers which prevented disruption of the oil, splashing of oil out of the pots, and allowed space for the safe expansion of gases formed by arcs.

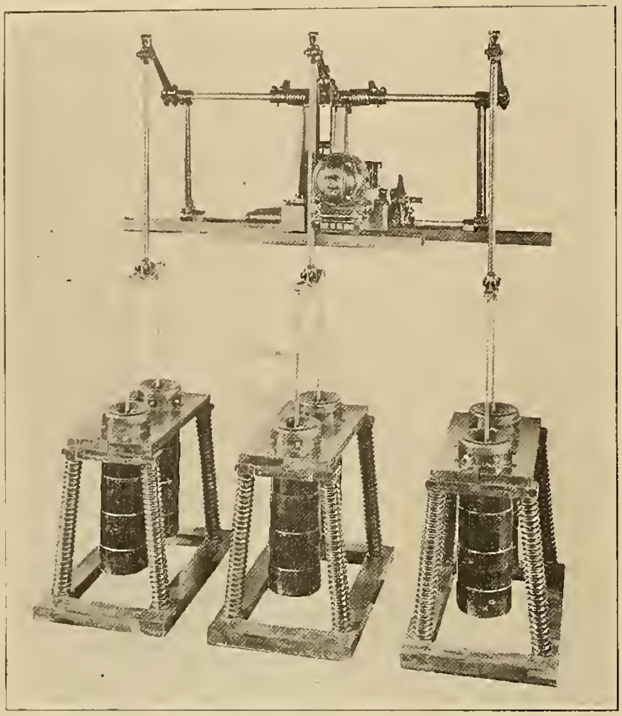


Fig. 1. General Electric High Tension H-3 Oil Switches.

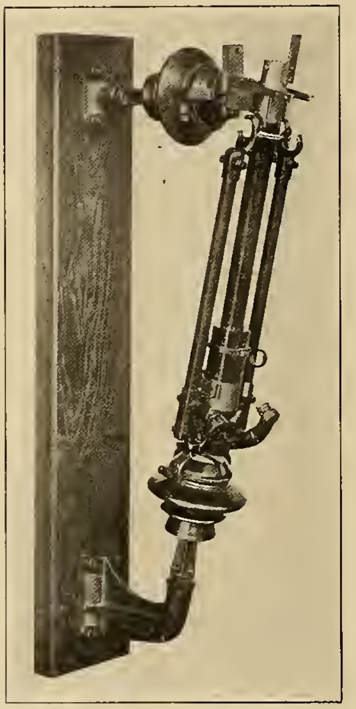


Fig. 2. General Electric Type T, Form D-4 Combined Fuse and Disconnecting Switch.

To increase the rupturing capacity, these switches are provided with explosion chambers surrounding the contacts. These confine the oil and force it at high pressure between the contacts at the point at which the arc is ruptured. The explosion chambers being entirely submerged in a larger volume of oil, any oil forced out by the expansion of gases is immediately and automatically replaced.

These switches are usually electrically operated and located at some distance from the point of control, but they have also been designed for hand operation. They are limited to systems of not over 60,000 volts. These switches, which are suitable for large power installations, are expensive, and to meet the condition where a small amount of power was to be tapped from a transmission line some simpler protective device had to be provided.

This problem was solved by the introduction of the expulsion type fuse. This fuse, mounted in a suitable holder which acts as a disconnecting switch for the circuit, permits opening the charging current of a line or the magnetizing current of a transformer, at the same time disconnecting the fuse holder from the circuit so that a fuse can be easily and safely removed or replaced.

These fuses, under proper conditions, furnish excellent protection for lines and apparatus, as, due to their property of generating a high pressure at the rupturing point of the fuse, and their quick action, the circuit is opened with little

if any more disturbance than where an oil switch is used.

There are a number of engineering features which should be carefully considered before deciding upon the use of fuses. Fuses should not be used:

(1) When the current to be ruptured exceeds the rating of the fuse, or when the capacity of the system exceeds the rupturing capacity of the fuse.

(2) Where the arc formed by the blowing fuse is objectionable.

(3) Where short interruptions of service, due to the time necessary to replace fuses, is an objection.

(4) Where overloads or short circuits are frequent, and circuits should be opened selectively after a time limit. In the cases given above oil switches should be recommended.

To meet the demand for a moderate capacity, reliable switch which could be installed at a less cost than the large capacity switch, a new type of oil switch has been designed. In this switch each pole, consisting of two breaks in series, is assembled in a separate iron tank of large dimensions. The three poles necessary for a three-phase circuit are operated as a unit by one mechanism, either by means of a hand operated lever, by air or by solenoids electrically operated from the central board.

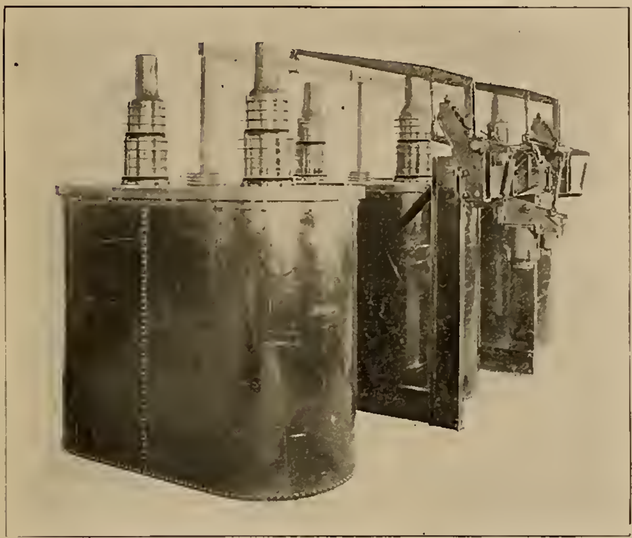


Fig. 3. General Electric Type F, Form K-10, T. P. S. T. 110,000 Volt 100 Ampere Oil Switch

This switch does not require isolating cells for the oil tanks, these being simply set up on the station floor, the spacing and size being varied according to voltage, the limit of which is 110,000 volts.

High capacity oil switches have been designed along the lines of the one last mentioned which are capable of handling the largest powers yet developed, at any voltage considered up to the present time. In order to provide the necessary insulation between live parts to take care of the higher voltages, spacings and break distances have been increased. The oil tanks are larger and contain a greater volume of oil.

These switches, being top connected, admit of a simple and flexible station layout. All wiring being overhead, station buildings do not require basements, and can, therefore, be constructed more cheaply than when bottom connected switches are used. The absence of cell work and barriers, also tends to greatly reduce the cost of installation.

In order to provide automatic protection for apparatus under abnormal conditions of overload or short circuits, two schemes are now in general use.

The first, and oldest, employs series transformers, the primaries of which are connected in the high voltage circuit to be protected. The secondary winding, suitably insulated from the primary, is connected either direct, or through suitable relays to the coil which attracts the tripping mechanism of the switch controlling the circuit.

The second uses relays, thoroughly insulated from the ground, the solenoids of which are connected directly in the main circuit. These operate the tripping mechanism of the switch either directly by means of insulating rods, or by means of an auxiliary source of power and a trip coil on the switch mechanism. These relays are designed only as single pole units one of which is connected in each line wire, and are not suitable for conditions which require the bringing together of two high voltage circuits in one unit.

Where wattmeters or watthour meters are required series transformers are necessary and can be used to operate protective devices in addition to carrying the instrument load.

Fig. 4. General Electric 110,000 Volt, Type F. Form K-15 Oil Switch.

A satisfactory indicating device for use on high voltage circuits is formed by mounting a standard ammeter on a suitable insulator to prevent leakage to ground. These instruments are connected directly in the main circuits, and should be so mounted that accidental contact with them by the station attendant is impossible. These instruments are used in those installations which lend themselves to the use of series relays, and together they form a compact and cheap equipment.

Disconnecting switches of various forms are in general use on high voltage circuits. These, as a rule, are not intended to open a power circuit, but can be depended upon to open the magnetizing current of a transformer or charging current of a line.

The well known knife-blade type is widely used, the spacing and break distances being proportioned to the voltage. These switches are invaluable for isolating stations or apparatus in stations at times when it is necessary to do work on the apparatus without shutting down an entire system.

Switches capable of opening a moderate amount of power have been perfected for outdoor use. These are mounted on a pole or tower structure and may be operated from the ground by means of a suitable mechanism.

The final breaking of the arc is accomplished on metal horns which, bending upward and outward, allow the arc to follow its natural course upward and to rupture itself at the ends of the horns.

The most difficult problem in high voltage development and one on which the success of any power transmission scheme depends, has been the production of suitable insulation for the lines.

As the lines are exposed to all weather conditions, traverse long stretches of exposed country, and are compelled to make numerous bends and to follow the natural grades, it has been necessary to produce insulators to meet any and all service conditions.

With the old style pin insulator construction line voltages were limited to about 60,000 volts, due to the great weight of the insulators for higher voltages and the high cost of towers, which had to be erected at close intervals.

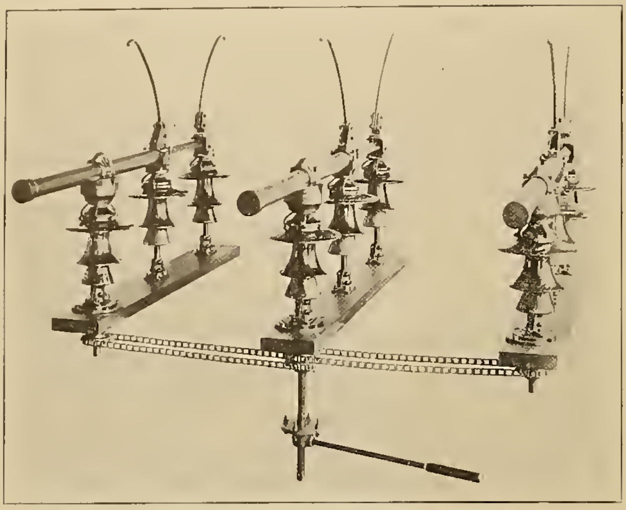


Fig. 5. General Electric 70,000 Volt T. P. S. T. Bolt Type Outdoor Disconnecting Switch.

Higher voltage transmission has been made possible by the introduction of a new insulator, known as the link type. These are made in two forms, one known as the suspension type, and the other as the strain type.

Each complete insulator consists of a number of porcelain units joined together by suitable links, the number of units in series being varied in proportion to the line voltage. Using these insulators it has been possible to greatly increase the distances between supports and to reduce the cost of lines to a practical basis.

THE AMERICAN INDUCTION MOTOR STARTER.

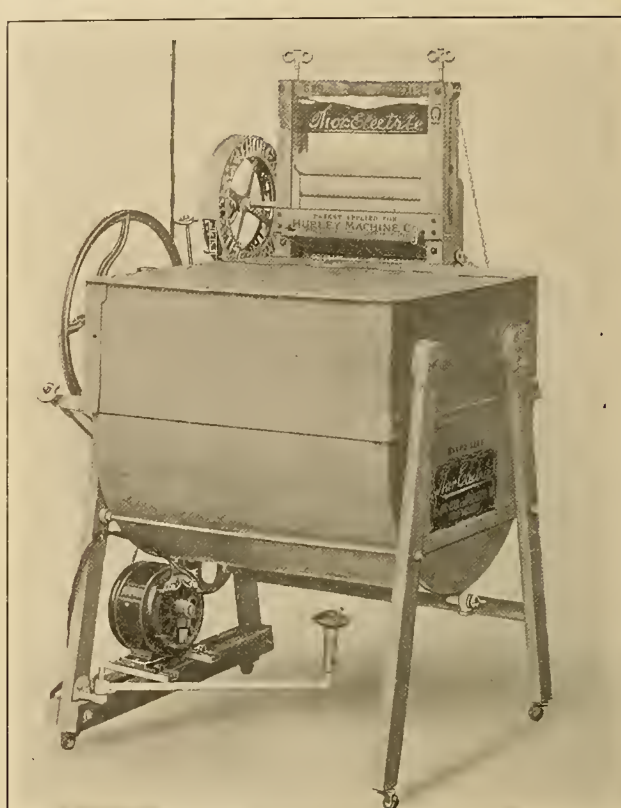
The American induction motor starter manufactured by the American Electric Fuse Company, Muskegon, Mich., has been designed as a substitute for the auto-transformer starting devices for squirrel-cage and slip-ring induction motors. By means of its resistors, which consist of a column of graphite discs in an insulated steel tube, it accelerates the motor evenly and gradually, takes a low starting current and introduces no wattless current. The resistance is varied by changing the compression on the column of discs, maximum resistance being obtained with minimum pressure and minimum resistance with maximum pressure.

In operation and appearance it is much like an ordinary knife-blade switch equipped with an eccentric mechanism for compressing the resistor and cutting it out of circuit. It is simple and light, has no brushes or contact plates and will not arc at the switch-points. It automatically adjusts itself to any load and produces only a slight drop in line voltage. In a comparative test between an American a.c. compression rheostat and an auto transformer in starting a 10 h. p. 440 volt three-phase induction motor under a moderate load, the auto transformer took a starting current of 60 amperes per leg with 200 volts at the motor terminals and caused a drop in line voltage from 410 to 375 whereas the American took from 25 to 40 amperes (depending upon the time to bring to speed, with a voltage of 175 at the motor terminals and a drop in line voltage from 410 to 395. The starting curve rises smoothly to a low maximum and drops easily to the running level, showing that all surging is eliminated.

LARGEST ORDER FOR MOTORS.

The largest order for small electric power motors ever placed with any electric manufacturer has been placed with the Westinghouse Electric & Manufacturing Company, Pittsburg, Penn., by the Hurley Machine Company, Chicago and New York, manufacturers of the "Thor" electric home laundry machine. The Hurley Machine Company has decided to adopt the Westinghouse motor as its standard.

The "Thor" machine is manufactured in three sizes;



"Thor" Electric Laundry Machine

No. 1, which is designed for the ordinary home, and No. 2 and No. 2½, which are intended for the large home, small hotel, boarding house or hospital. The same type of construction is followed in all these machines. The washer is of the reversing cylinder type. The cylinder is constructed of wood, no metal parts of any nature coming in contact with the clothes, all of which are held in the wooden cylinder and rotated through one complete revolution in one direction, then in the reverse direction, and so on. The reversing mechanism is located at the side of the tub and consists of a ratchet reversing gear, the patents of which are held by the Hurley Machine Co.

A three-roll wringer is a part of each machine and is mounted at the back of the washer. The three-roll feature has a direct advantage in that clothes can be sent through it from both directions.

An additional attachment, which is of particular use, is the gas burner, connected under the washer. It is only necessary to connect this burner with the gas system of the house, and the water can be heated and kept hot during the process of washing.

Upon the "Thor" laundry machine is used a specially wound high torque Westinghouse type DA motor, 1700 r.p.m., 60 cycles, 110 or 220 volts. Like most small motors it can be connected directly to a lamp socket. These motors are supplied with sliding bases and are mounted upon a small bracket, which is supported by a cross arm extending between two legs of the washer. The motor pulley is belted directly to the counter-shaft, which in turn is connected to the reversing mechanism that drives the washer, and also to the pulley operating the wringer.

A TRADE PUBLICATION EXTRAORDINARY.

In "Luminous aud Flame Arcs versus Open and Enclosed Arcs" just from the press of the General Electric Company of Schenectady, New York, Mr. W. D'A. Ryan gives a comprehensive, instructive and entertainingly told comparison of the accepted standards used for street illumination. This publication is a reprint of the paper which he read before the National Electric Light Association at the recent meeting in St. Louis, and is very timely, treating as it does a subject that is receiving widespread attention not only from central station men but from real estate men, merchants and the public at large.

Charts and curves of the types of lamps treated in the article are shown and in addition complete instructions in reading them are given. This feature gives it particular value to all those interested in street illumination. As the foremost illuminating engineer in the country, with the facilities of the extensive illuminating laboratory maintained by the General Electric Company at his command, Mr. Ryan is particularly well qualified to handle the subject.

In the introduction to the paper mention is made of the importance of illumination charts and curves and the psychological opposition usually met with in their use by uninitiated persons. The following are the types of lamps studied: The 9.6 ampere carbon open arc, commercially rated at 480 watts, equipped with clear globe and no reflector, the 6.6 ampere carbon enclosed arc, commercially rated at 480 watts and equipped with light opal inner, clear outer globe and street reflector, the 4 ampere luminous arc, commercially rated at 310 watts and equipped with clear outer globe, internal concentric diffuser and magnetite electrode, the 6.6 ampere luminous arc, commercially rated at 510 watts and equipped with clear globe, internal concentric diffuser and magnetite electrode, the 6.6 ampere vertical carbon flame arc, commercially rated at 510 watts and equipped with 26 in. concentric diffuser and light opal outer globe.

A polar curve and a hemispherical chart are shown, giving the characteristics of the various types, together with instructions in reading them and conclusions to be drawn. After this study of the characteristics of distribution and the relative spherical and hemispherical efficiencies, attention is turned to the illumination on the street and a foot candle curve is given.

Luminous Arc Lamps and Ornamental Poles, St. Louis.

The height of lamps above the street is studied carefully and two charts are shown that furnish a ready means of comparing the relative candle-power and resulting intensities for different spacings and heights of lamps.

It is stated that America has hardly advanced beyond what might be called "path-finding" street illumination, as it is not an uncommon condition to find lamps spaced 500 feet apart and in many cases 1000 feet apart, showing that the public has heen more or less satisfied with making one lamp light from 5 to 28 acres, or that is what it would amount to if the lamps were placed in an open space. The wattage used per linear foot of street in European cities will be com-

monly found to exceed American practice, being anywhere from two to three times as great.

While street arcs are employed largely for linear lighting, that is up and down the street, there are many cases where open squares, parks, etc., must be illuminated, and a chart is shown giving a comparison of the arcs over which the various lamps will project a given minimum light.

The values of the various types of lamps spaced at 500 and 1250 feet respectively are illustrated in two sector plates. Broadly, the relative illuminating power of the various units for distances of 250 feet and beyond, indicating the number of lamps required of each type, if massed at one point, to equal one Boston Flame Arc, is as follows:

6.6 ampere Boston Flame arc	1 lamp
6.6 ampere Luminous arc	2 lamps
4 ampere Luminous arc	4 lamps
6.6 ampere Enclosed carbon	5 lamps
9.6 ampere open carbon	7 lamps

the amount of light projected directly on the street surface. With the pole spacing used at the present time a great improvement in street lighting is possible by the substitution of the 4 ampere luminous arc for the open carbon, and the enclosed carbon arc, or, if a still higher illumination is required, the 6.6 luminous arc lamp can be used in conjunction with vertical carbon flame lamps for parks, squares, or dangerous intersections or places where an exceedingly large illumination is required.

Summarizing, Mr. Ryan says that one of the strongest features of the present conditions of the art of street lighting is that there is now available, three high efficiency units which can be operated in series on the same circuit. The 6.6 ampere luminous arc for lighting the principal streets. The 6.6 ampere Boston flame arc for lighting parks, squares, and other places. The 6.6 ampere Mazda units for residential and incidental lighting. These should materially assist in a

Night Photograph Illustrating Illumination of Broadway, St. Louis, With Luminous (Magnetite) Arcs.

The Boston type of lamp referred to is the vertical carbon flame lamp recently placed on the market by the General Electric Company and is termed Boston type because the first fifty were placed in service in that city to light the principal parks and squares.

The chapter captioned "X values" treats, in an interesting way, the specifications adopted at the 1907 meeting of the National Electric Light Association. Briefly, the X value indicates the relative strength of the light as compared with a standard 16 candle-power incandescent lamp at a fraction of the distance. An arc lamp, for example, having an X value of 4, gives the same light as a 16 candle-power incandescent lamp at one-fourth of the distance, all of the measurements being taken in accordance with definite specifications. In this chapter are given the X values of the types of lamps dealt with by Mr. Ryan.

In conclusion it is stated that large units should be used to light the principal streets of a city and that a large volume of light reflected from the buildings is quite as important in giving the city the appearance of being well illuminated as marked improvement of street illumination. Daytime photographs are shown of streets in Minneapolis, Detroit, Toledo, St. Louis, and Boston. These were made especially for this publication by the General Electric Company's expert night photographer, Mr. Norris. Two very interesting photographs are those of Park Square, Boston, both taken at the same point, one by daylight, the other at night, the latter illustrating the illumination by the vertical carbon flame lamps hung there.

The thirty color charts and illustrations are of unusual merit and the typographical excellence does credit to the printer's art. An interesting side light is the fact that the multiplicity of the colors used in the illumination charts necessitated the work being put through the press six times. In anticipation of the enormous demand that there will be for this publication, the General Electric Company has had an exceptionally large edition printed. "Luminous and Flame Arcs versus Open and Enclosed Carbon Arcs for Street Illumination" will be for years to come a criterion of trade publications.

NEWS NOTES

INCORPORATIONS.

LIBBY, MONT.—The Libby Water works, Electric Light & Power Company has been incorporated by G. A. Shaffer, for $350,000.

EATONVILLE, WASH.—Tacoma Telephone & Telegraph Company, capital $3000, has been incorporated by A. E. Dye and Isabella Dye.

PORTLAND, ORE.—The Stein Mountain Power & Irrigation Company, capital $25,000, has been incorporated by A. O. Jones, G. G. Jones and T. Burns.

SEATTLE, WASH.—The Commercial Wireless Telephone & Telegraph Company, capital $1,000,000, has been incorporated by Fred H. Shoemaker and John Bradfield.

SAN FRANCISCO, CAL.—The Owens River Valley Electric Railway Company has been incorporated by C. Hillyer, E. A. O'Brien, M. R. Jones, G. Carter, R. C. Pardee, T. W. Forsyth and D. D. Oliphant, with a capital stock of $200,000.

SAN FRANCISCO, CAL.—The Sanitary Telephone Mouthguard Company has been incorporated by G. A. Moore, J. L. Gould, J. L. Miller, G. H. Bandry, F. A. Brown, E. R. Blake, R. P. Rogers, J. W. Scott and F R. Grother, with a capital stock of $300,000.

FINANCIAL.

KINGSBURG, CAL.—Kingsburg has voted in favor of issuing $26,000 of bonds for a municipal water system and fire protection.

SACRAMENTO, CAL.—The election last week resulted in a defeat for the second time of the plan to bond the city for a filtration plant.

CORTE MADERA, CAL.—Corte Maderans voted on bonds for lighting and fire districts. The following was the vote: Lighting district, for 43, against 3. Fire district, for 30, against 17.

TRANSMISSION.

OAKLAND, CAL.—The Great Western Power Company has been awarded a franchise to operate its electric power system in Albany to the north of Berkeley.

SAN FRANCISCO, CAL.—The Hydro-Electric Company, which has been temporarily enjoined from running a pipe line across the Mono National Forest Reserve, has applied for a permit.

TACOMA, WASH.—Savage & Nichols have been awarded the contract for the building of the upper portion of the Nisqually power system. The work on which bids have been let is the building of a dam in the Nisqually river and of a 10,000-foot tunnel, and a contract will soon be let for the transmission line.

OROVILLE, CAL.—The Great Western Power Company is to enlarge its Island Bar power house. There are now four dynamos used for the purpose of power generation at the plant. As the plans are reported, another dynamo will be added. This addition will enlarge the plant by one-fourth its size. The demand for the energy in excess of that now generated will easily be found in San Francisco and Oakland. Since the consolidation of the Great Western with the Pacific Gas and Electric, the latter concern has been selling all of the power generated at its own plants as well as that of the Big Bend plant. There are now four units in the Big Bend plant, the unit being determined according to the number of dynamos in use.

SPOKANE, WASH.—The National Power Company of this city with offices in the Columbia Building will thoroughly remodel its big plant at Bishman, a few miles east of Spokane. A number of new buildings are to be constructed and a large amount of new modern machinery will be installed by the first of the coming year at a cost of $40,000.

OROVILLE, CAL.—Water is now running over the top of the big concrete dam of the Great Western Power Company at Intake, in the Feather river canyon, and has backed up the canyon several miles, forming a great lake. The dam is 86 feet high from the bed of the river and 285 feet long on top between the rocky walls of the canyon. It is seventy-five feet wide at its base. It is of solid rock and cement, 1000 carloads of the latter material being used in its construction.

OROVILLE, CAL.—With the filing by Mrs. M. E. Lague upon 30,000 inches of water in the Middle Fork of the Feather river, to be carried to a power-house at the junction of Bear river and the Middle Fork, filings amounting to 110,000 inches of water from Bear and Falls creeks and the Middle Fork for the same power plant have been posted. It is only a short time ago that Stanley Lague filed upon 30,000 inches of water to be carried to the same high hill near the junction of Bear creek and the Middle Fork. Mrs. Lague's point of diversion is in section 25, township 23 N, R 8, Plumas county. The ditch that will carry the water will be 20 miles in length and will receive its water from a dam 80 feet high, 275 feet across the stream and 40 feet through.

TRANSPORTATION.

SAN DIEGO, CAL.—The Adams avenue electric line is to be extended next year from its present terminus to Kensington Park tract, which lies to the east.

LEWISTON, IDAHO.—Attorney J. B. West announces that within a short time capitalists will file applications for a franchise to enable the construction of an electric railway at this place and to install a lighting plant.

SEATTLE, WASH.—Fred E. Sander, who was associated with the construction of the Seattle-Everett interurban, announced that he will apply to the county commissioners for a franchise to construct a line to Lake Burien, 7 miles south of Seattle.

SANTA MONICA, CAL.—Official announcement has been made that the Southern Pacific Railroad Company's Santa Monica steam line is to be converted into an electric line as far as Palms as soon as possible. This old line has already been put under electricity west of Palms by the Los Angeles Pacific Railway Company.

HAYWARDS, CAL.—An application for a franchise for an electric street railway to run from the Southern Pacific station up C street to Commercial street, to B street, to the town limits and then through the Castro Valley district as far as the school house, a distance of about four miles, has been presented by I. B. Parsons, president of the Bank of Haywards. Work will commence as soon as the franchise is granted.

PORTLAND, ORE.—John F. Stevens, chief executive of the Hill steam and electric railway interests in Oregon, has returned to Portland, after an absence in the East, and announces that the Hill interests will spend from $7,000,000 to $10,000,000 in extensions of the United Railways and the Oregon Electric within the next year or 18 months. This will mean an addition of from 200 to 250 miles of electric lines tributary to Portland.

MARYSVILLE, CAL.—The franchise across F and Third streets, asked by the Northern Electric Company, has been granted with only one change. The Northern Electric Company owns all the property on the block on F street between Second and Third streets, except one lot, and by the agreement made the electric company will fill and grade the entire block. The company also agreed to place an automatic gate on the crossing at Fourth and Willow streets, and to stop all switching on Fifth street. The Northern Electric wished to obtain the franchise to reach the site of the new depot on E street between Second and Third streets, a block from the present depot, and to do so it is necessary to cross Third and F streets.

CHICO, CAL.—The Northern Electric is building the largest electric freight locomotive in the State in the local shops. It will be completed inside of a month or six weeks. Work of construction has been going on all fall and summer. The locomotive will be equipped with a 600 h.p. motor, while those now in use have but 360 h.p. It will be used on the Chico-Sacramento run. The Northern Electric is making many improvements in its tracks for the winter season. All of the bridges between this city and Sacramento have been strengthened, and the embankments have been made doubly strong, to prevent their being damaged by floods. The pontoon bridge across the Sacramento river, on the Hamilton City line, will not be removed until well along in December.

ILLUMINATION.

SAN BERNARDINO, CAL.—This city is next year to have a municipal electric lighting plant.

MANILA, P. I.—The Manila Gas Company, contemplates erecting a plant on a new site which is to cost about $50,000.

WILLOWS, CAL.—The manager of the Willows branch of the Northern California Power Company has given out that this city will soon have a gas plant.

COLUSA, CAL.—C. F. Downing, William Whales and Mr. Steele, officials of the Pacific Gas and Electric Company, have been arranging for the commencement of work on the new power line. The new line will carry a voltage of 15,000 and on completion the old line from Gridley will be abandoned. The work on the sub-station will commence at once.

TACOMA, WASH.—The Tacoma Gas Company on South A street is preparing plans for its new modern gas plant to be built next year on the tide lands. It is situated east of the Carstens Packing Company, bounded by the river street on the east and the Northern Pacific main line right of way on the south. The cost of the new plant will be from $250,000 to $300,000.

LOS ANGELES, CAL.—The Board of Public Works has recommended to the Council that 62 street lights be installed in the Cahuenga district recently annexed. The cost of maintenance it is estimated will be about $2000 for the remainder of the fiscal year. The Board recommends that this amount be taken out of the $6755.77 road taxes collected from district and transferred to street lighting funds.

TAFT, CAL.—The recent incorporation of the California Natural Gas Company will result in the use of a large amount of the gas developed in the Midway fields. The present plan embraces the supplying of gas for fuel to operating companies, and contemplates extending the system to different towns for heat and light purposes. The new company has contracted with the Standard Oil Company for the product of its gas wells, and on the amount of supply will depend the extent of the system. From the number of gas wells so far developed, there is promise that the quantity of gas to be secured is practically limitless. At the Standard's yards on Section 14 the new company has sixty miles of 4-inch Dressler coupling pipe for its mains throughout the fields, also a quantity of meters and other accessories.

FRESNO, CAL.—The San Joaquin Light & Power Company has taken the preliminary steps for the establishment of a pole treating plant near Fresno. This plant, when completed, will have cost over $10,000 and is to be located on ten acres of land already purchased for the purpose and lying on the S. P. at the point known as the "Y." When the plant is placed in operation every pole that goes into the ground in the company's system from Bakersfield on the south to Merced on the north will have that portion of it which is to go into the earth treated with creosote. By this treatment it is expected that the usefulness of the poles will be prolonged four times over what it is at present. The work is to be in charge of W. R. Wheaton, who is at present in the employ of the San Joaquin Light & Power Company, but who originally came from the Forestry Department at Washington, D. C. The manner of treating the poles at the local plant will be in accordance with a method devised by Wheaton as the result of over two years of experimenting at Crane Valley.

WATERWORKS.

LOS ANGELES, CAL.—The Board of Supervisors has passed ordinance No. 251 granting to the Angeles Mesa Land Company a franchise for a water system in No. 668 tract.

SAN DIEGO, CAL.—The San Ysidro Association will take over the business of the Little Landers Corporation. To finance a deal the association will form an irrigation district and bond it for $20,000 and build its own water plant.

ASHLAND, ORE.—The City Council has paid Engineer W. J. Roberts $1000 for his plans and specifications for the reconstruction of the Ashland municipal water system containing two reservoirs. The estimates are about $160,000.

POMONA, CAL.—The Consolidated Water Company has struck water in its tunnel at Claremont and it is understood that this new tunnel will add materially to the water supply, for it is evident that a new water stratus has been tapped.

WALLA WALLA, WASH.—The Council has passed an ordinance providing for the laying of water mains beginning at the intersection of Boyer avenue and Roosevelt street, and running thence north on Roosevelt street and Garden street; thence east on Garden street to the city limits of Walla Walla according to the plans filed in the office of the City Clerk.

RED BLUFF, CAL.—Mrs. Lewis Thompson recently filed on 3000 inches of water in Cottonwood creek, in Section 19, Township 29 North, Range 4 West. The water will be used for irrigation and domestic purposes. It will be diverted by means of a pump on the south bank of the creek and conveyed through ditches and a flume to the places of use.

CORONA, CAL.—The Temescal Water Company will supply Corona with water for domestic use at a cost of $60,000. The Company has made arrangements for a new 20 in. pipe line from its artesian wells in Temescal to this city. The line will be of concrete and steel and will have a capacity of 800 inches. It is hoped to have the line in operation by April 1st.

ELLENSBURG, WASH.—A report by the City Engineer, G. N. Miller, on a municipal water system for the city to be built at an estimated cost of $300,001.74 has been adopted. W. J. Payne, the city attorney, has been instructed to prepare a statement of the matter to be presented to the people at the general city election in December, at which time will be decided whether such a system shall be built.

ELLENSBURG, WASH.—The estimate of the city engineer submitted to the Council shows that the water is to be taken from Cle Elum river about 32 miles distance. The elevation above Ellensburg is 535 feet. With 16-inch pipe the daily delivery will be 2,500,000 gallons. The cost is given at $300,000 in round figures and the plan contemplated will supply a population of at least 25,000. The distribution system would require about 15 miles of 4 in. pipe.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 23 — SAN FRANCISCO, DECEMBER 3, 1910 — PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXV | SAN FRANCISCO, DECEMBER 3, 1910. | NUMBER 23

FRICTION OF FLAT DISCS ROTATED IN WATER

BY JOSEPH N. LE CONTE.[1]

The object of the series of tests herein described was to determine the effect of diameter and speed upon the power necessary to rotate flat circular discs in water, and also the effect of the width of space between the moving plate and the stationary walls of the containing vessel. To a certain extent the effect of temperature on power consumption was touched upon, and in one instance the effect of rusting the surface.

investigated the power consumption on discs only up to 12 in. diameter, and with comparatively low speeds. He did not publish any information on the effect of the space between fixed and rotating plates upon power consumption, and in his results assumed the power to vary as to the cube of the speed and fifth power of the diameter, making up the difference between theory and actual observations by a variable coefficient.

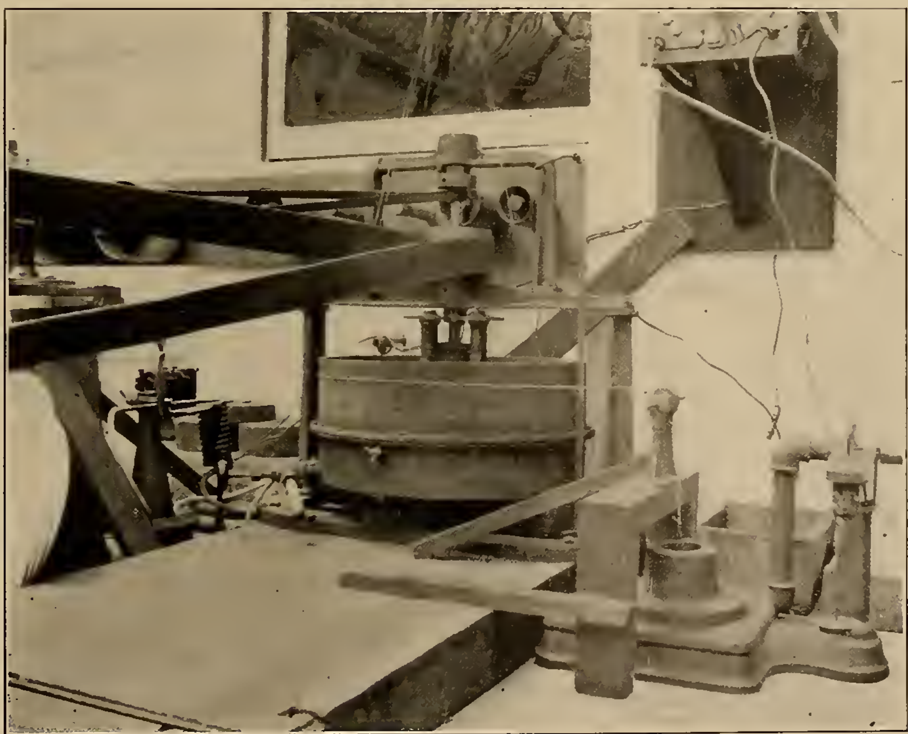

Photo by H. F. Fischer Experimental Apparatus for Determining Friction of Flat Discs Rotated in Water.

Work along similar lines has been done by Prof. Jas. Thomson, as described in the Transactions of the Royal Society, 1855, and by Prof. W. C. Unwin in the Proceedings of the Institution Civil Eng. in 1885. These tests were all made on low speeds, and on a comparatively small scale.

Prof. F. G. Hesse carried on a series of tests similar to and with an apparatus identical with ours, but

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The tests described in this paper cover the ground more fully than those made by Prof. Hesse, and the apparatus used was larger, and the speed control better than he was able to use. It was not possible, however, to investigate fully many interesting features, particularly those connected with temperature, and with end thrust due to unsymmetrical spacing.

Description of Apparatus.

Fig. 1 shows the general arrangement of the testing apparatus. It consisted of a hollow cylindrical cast

iron shell M N, divided across the middle horizontal plane at oo'. This shell was finished inside, and the two halves bolted together with a water tight gasket. The shell or container rested upon a hardened steel pivot K, and was held in a vertical position by four rollers R, touching upon the projecting end of a bronze bushing, which also formed the bearing of the rotating shaft. A piano wire suspension S S T passed over a pulley about 20 ft. above the apparatus, and weights on the other end counterbalanced all but about 15 lb. of the weight of the container and its charge of water. The friction at the pivot K was therefore small, and was still further eliminated by the jarring of the frame when the disc was run at high speed.

The disc to be tested was fastened to the lower end of a vertical steel shaft exactly in the axis of the container. End play was prevented by means of the

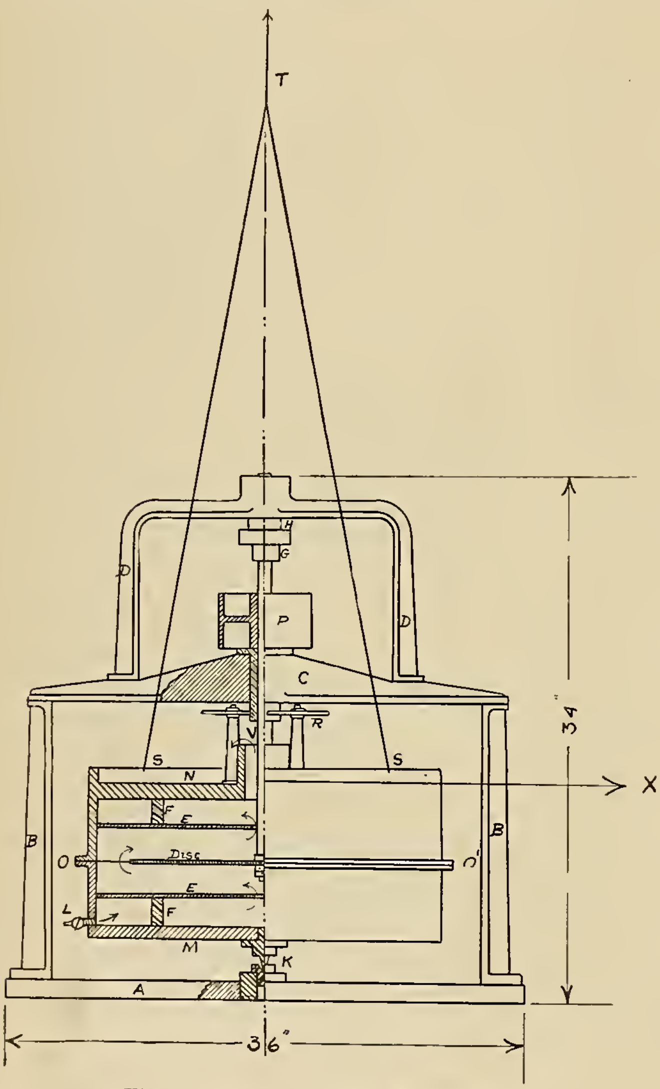

Fig. 1. Sketch of Testing Apparatus.

collar H and the pulley P. The disc rotated in the middle plane of the container, and between the stationary brass plates E E, which were finished upon the sides facing the rotating disc. These stationary plates were held in position by the posts F F, and the distance between the stationary and movable plates could be varied by varying the length of these. The joint between the stationary plates and the cast iron shell was made water tight with great care in order that no leakage or pumping action should take place there.

Power was supplied by a direct current motor to a countershaft, and then through a quarter turn belt to the pulley P. Large variations of speed were effected by changing the pulley size on the motor. A sensitive tachometer was belted to the disc shaft by a quarter turn belt on the pulley G. By means of a rheostat in the field of the motor the speed of the disc could be held accurately at a fixed value.

As the absorption of a very considerable amount of power would rapidly raise the temperature of the water, and as the friction depended to some extent on the temperature, some sort of water circulation was a necessity. This was accomplished by admitting a stream of cold water at the pet cock L through flexible tubing. The circulating water then passed through a hole in the center of the lower stationary plate, then radially outward below and radially inward above the rotating disc, finally escaping around the main shaft, and overflowing the shell at V. The temperature of the water was taken with a thermometer at V and also in the space between the stationary plates by means of an opening at O. Whatever disturbances were created by the radially outward flow below, seemed to be exactly balanced by the radially inward flow above the moving disc, as a temporary shutting off of the circulating water in no way disturbed the balance of the apparatus when running full power.

The power absorbed by the rotating disc was measured by noting the reaction of the container about its pivot K. This was done by wrapping a cord about the outside of the shell and measuring the force X with a small platform scale. If R is the outside radius of the shell, N the revolutions per minute of the shaft carrying the disc, and X the net pull on the string, then:

$$\text{H. P.} = \frac{2\pi RNX}{33000}$$

and calling $\frac{2\pi R}{33000} = K$, H. P. $= K N X$.

In the present instance K was found to be .0001788.

Six brass discs and two iron ones were tested. All the careful work, and all work involving variations in spacing, was done with the brass discs, for the reason that their surfaces were identical with those of the stationary plates, and also that these surfaces did not tarnish with prolonged use. The actual radii of the brass discs were 8 in., 10 in., 12 in., 14 in., 16 in. and 18 in., but since the cylindrical edges of the discs due to their thickness play a very important part, the velocity being highest there, the approximate virtual radii were computed by adding ½ the thickness of the plate to the radius, according to the following table.

BRASS DISCS.

Actual		Virtual	
Diam.	Radius	Diam.	Radius
8	4	8.15	4.075
10	5	10.15	5.075
12	6	12.16	6.084
14.015	7.007	14.16	7.08
16	8	16.16	8.08
17.97	8.985	18.13	9.065

CAST IRON DISCS.

12	6	12.47	6.235
18	9	18.50	9.25

The distance between the stationary and movable discs was changed four times. These spaces were 0.125, 0.266, 0.535 in. with the stationary brass discs in place, and 3.83 in. when they were entirely removed leaving the top and bottom of the iron shell only. The tests with the iron discs were made under these latter conditions only.

No elaborate tests on the effect of temperature on resistance were made, but only sufficient data was obtained along this line to give an approximate empirical formula by which the effect of slightly varying water temperature encountered from day to day could be reduced to a standard temperature at 65 degrees F. This was done by passing the circulating water through a coil of iron pipe heated by a large Bunsen burner, until the temperature conditions became constant. The formula assumed was:

$$(H.\,P.)_{65} = HP\ (1 + C\ (t - 65))$$

The coefficient C was found to follow approximately the law

$$C = a\,\frac{1}{d^n\,s^m} \quad \text{or} \quad 0.524\,\frac{1}{s^{0.2}\,d^{2.1}}$$

The manner of conducting a set of tests was as follows: The stationary discs were first adjusted accurately parallel to the parting plane of the two halves of the shell and at the correct distance apart. The shell was then bolted up, filled with water, and the shaft run at high speed without any disc. The slight torque was then measured, and was used as a zero reading, being subtracted from all subsequent readings with discs attached. This slight zero correction was due to slight errors in balance of the large mass and initial torsion in the piano wire suspension. The shell was then emptied, the two halves unbolted and the first disc attached to the shaft. After bolting up the shell again, the disc was adjusted exactly midway between the two stationary plates. This adjustment in the case of small spaces was of great importance, for if the rotating plate was not central it was powerfully drawn toward the nearer plate. This attraction was so great as in several instances to lift the entire weight of the apparatus, amounting to 150 lb. off the pivot K.

The disc was then brought up to speed and the torque noted while the speed was held constant on the tachometer by means of a field rheostat. A test at higher speed was then made and so on, the motor pulley being changed from time to time and the temperature of the circulating water being noted. After a complete set of tests on one disc, others were inserted until all six had been tried with the given spacing. In addition runs at different temperatures were made, and finally a second trial was made with no disc in order to check the zero reading.

The machine was then taken down, the posts F F cut off and a similar set of readings made at the new spacing, and so on. The results of the work are as follows:

18 in. BRASS DISC.

⅛ in. Space Speed.	Pounds Force.	H.P	True Temp. Fahrenheit, degrees.	H.P. corrected to 65° Fahr.
420	2.15	0.161	62.8	0.1604
512	3.10	0.277	63.3	0.276
626	4.40	0.493	63.3	0.4915
718	5.70	0.723	63.8	0.731
820	7.10	1.041	63.8	1.038
923	8.80	1.453	63.3	1.450
1025	10.70	1.961	62.8	1.953
0.266 in. Space.				
404	2.14	0.154	70.8	0.155
505	3.20	0.288	70.8	0.291
606	4.44	0.471	70.8	0.471
707	5.92	0.748	70.8	0.755
808	7.82	1.130	70.8	1.140
909	9.84	1.600	71.8	1.616
1010	11.99	2.165	72.8	2.192
1111	14.02	2,785	73.8	2.825
1212	16.72	3.625	74.8	3.68
0.535 in Space.				
430	2.55	0.196	61.8	0.195
505	3.48	0.314	61.8	0.313
606	4.79	0.518	61.8	0.515
707	6.26	0.79	61.8	0.786
808	7.99	1.155	61.8	1.15
909	9.70	1.575	61.8	1.568
1010	11.70	2.11	61.8	2.10
1111	14.51	2.88	61.8	2.866
3.828 in. Space.				
597	5.01	0.535	58.2	0.531
697	6.76	0.842	58.2	0.836
796	8.79	1.25	58.2	1.24
896	10.99	1.76	58.2	1.747
995	13.39	2.38	58.2	2.36
1095	16.11	3.15	58.2	3.15
1194	18.86	4.03	58.2	4.03
1293	22.31	5.16	58.2	5.16

16 IN. BRASS DISC.

⅛ in. Space Speed.				
461	1.61	0.133	65.8	0.133
513	2.00	0.184	65.8	0.184
615	2.72	0.299	65.8	0.2996
718	3.65	0.469	65.8	0.470
820	4.60	0.675	65.8	0.676
922	5.67	0.935	65.8	0.937
990	6.60	1.168	64.8	1.167
0.266 in. Space.				
606	2.78	0.301	60.8	0.298
707	3.68	0.465	60.8	0.461
808	4.76	0.688	61.8	0.683
909	6.30		62.8	
1010	7.21	1.302	63.8	1.292
1111	8.66	1.722	63.8	1.708
1212	10.10	2.190	64.8	2.172
0.535 in. Space.				
606	2.87	0.311	58.8	0.307
707	3.80	0.480	58.8	0.475
808	4.80	0.693	58.8	0.685
909	6.30	1.022	58.8	1.01
1010	7.40	1.335	58.8	1.32
1111	8.86	1.76	58.8	1.74
3.828 in. Space.				
697	4.22	0.525	57.8	0.521
796	5.54	0.788	57.8	0.782
896	6.82	1.09	57.8	1.080
995	8.32	1.48	57.8	1.466
1095	9.87	1.93	57.8	1.913
1194	11.62	2.48	57.8	2.46
1293	13.42	3.10	57.8	3.07
1392	15.52	3.87	57.8	3.84

14 IN. BRASS DISC.

⅛ in. Space Speed.				
513	1.10	0.101	64.8	0.1009
636	1.59	0.1808	64.8	0.1806
718	2.04	0.262	63.8	0.2606
820	2.70	0.396	63.8	0.394
923	3.35	0.552	63.8	0.55
1025	4.10	0.752	63.8	0.749
1111	4.78	0.950	63.8	0.946
1212	5.62	1.219	63.8	1.213
1313	6.43	1.51	63.8	1.503
0.266 in. Space.				
606	1.50	0.162	71.3	0.165
707	2.05	0.259	71.3	0.263
808	2.63	0.38	71.3	0.386
909	3.34	0.543	71.3	0.5515
1010	4.10	0.740	71.3	0.752
1111	4.92	0.977	71.3	0.994
1212	5.74	1.245	71.3	1.266
1313	6.43	1.51	71.3	1.535
1414	7.59	1.92	71.3	1.95
1515	8.80	2.38	71.0	2.416
0.535 in. Space.				
606	1.63	0.176	58.8	0.173
707	2.25	0.284	58.8	0.280
808	2.84	0.41	58.8	0.404
909	3.54	0.575	58.8	0.576
1010	4.26	0.769	58.8	0.758
1111	5.03	1.00	58.8	0.986
1212	6.05	1.31	58.8	1.290
3.828 in. Space.				
896	3.83	0.612	57.8	0.606
995	4.80	0.855	57.8	0.846
1095	5.67	1.11	57.8	1.098
1194	6.68	1.43	57.8	1.413
1293	7.72	1.785	57.8	1.765
1392	8.79	2.19	57.8	2.165
1491	9.86	2.63	58.8	2.604

12 IN. BRASS DISC.

⅛ in. Space Speed.	Pounds Force.	H.P	True Temp. Fahrenheit, degrees.	H.P. corrected to 65° Fahr.
808	1.22	0.176	64.8	0.176
909	1.58	0.257	64.8	0.257
1010	1.91	0.345	64.8	0.345
1111	2.32	0.461	64.8	0.461
1212	2.72	0.590	64.8	0.589
1313	3.20	0.751	64.8	0.750
1414	3.78	0.949	64.8	0.948
1515	4.23	1.146	64.8	1.145
1616	4.81	1.391	64.8	1.390
0.266 in. Space.				
909	1.65	0.268	67.8	0.271
1010	2.08	0.376	67.8	0.380
1111	2.60	0.516	67.8	0.521
1212	2.88	0.624	67.8	0.630
1313	3.33	0.782	68.8	0.793
1414	3.87	0.978	68.8	0.992
1515	4.38	1.185	69.8	1.206
1616	4.98	1.438	69.8	1.463
1717	5.55	1.700	70.8	1.735
1818	6.24	2.030	70.8	2.072
0.535 in. Space.				
909	1.75	0.286	56.8	0.278
1010	2.20	0.398	56.8	0.388
1111	2.77	0.55	56.8	0.536
1212	3.25	0.705	56.8	0.686
1313	3.77	0.885	56.8	0.862
1414	4.36	1.102	56.8	1.072
1515	4.75	1.285	56.8	1.251
1616	5.55	1.590	56.8	1.513
1717	6.07	1.865	56.8	1.816
1818	6.65	2.16	56.8	2.104
3.828 in. Space.				
896	1.98	0.317	59.8	0.313
995	2.38	0.424	59.8	0.419
1095	2.85	0.558	59.8	0.551
1194	3.37	0.72	59.8	0.711
1293	3.86	0.893	59.8	0.883
1392	4.38	1.09	59.8	1.077
1491	4.99	1.33	59.8	1.314
1591	5.59	1.59	59.8	1.571
1690	6.27	1.89	59.8	1.868

10 IN. BRASS DISC.

⅛ in. Space				
909	0.66	0.107	65.8	0.108
1010	0.80	0.144	65.8	0.145
1111	0.98	0.195	65.8	0.196
1212	1.18	0.256	65.8	0.257
1293	1.33	0.307	65.8	0.309
1414	1.60	0.404	65.8	0.406
1515	1.80	0.488	65.8	0.49
1616	2.08	0.602	65.8	0.605
1717	2.30	0.706	65.8	0.71
1818	2.64	0.858	65.8	0.864
1919	2.92	1.002	65.8	1.008
2020	3.25	1.174	65.8	1.176
0.266 in. Space.				
1010	0.81	0.146	68.8	0.148
1212	1.30	0.281	68.8	0.285
1414	1.59	0.402	68.8	0.408
1616	2.11	0.61	66.8	0.619
1818	2.67	0.868	66.8	0.882
2020	3.28	1.183	66.8	1.200
0.535 in. Space.				
1111	1.27	0.252	54.8	0.240
1212	1.47	0.319	54.8	0.304
1313	1.77	0.415	54.8	0.395
1414	1.98	0.500	54.8	0.476
1515	2.22	0.602	54.8	0.574
1616	2.50	0.722	54.8	0.688
1717	2.78	0.853	54.8	0.813
1818	3.09	1.004	54.8	0.958
1919	3.42	1.172	54.8	1.116
3.828 in. Space.				
1095	1.27	0.249	57.8	0.243
1194	1.51	0.322	57.8	0.315
1293	1.77	0.41	57.8	0.400
1392	2.07	0.515	57.8	0.503
1491	2.36	0.63	57.8	0.615
1591	2.70	0.768	57.8	0.75
1690	3.01	0.91	57.8	0.888
1790	3.26	1.042	57.8	1.018
1890	3.69	1.248	57.8	1.22

8 IN. BRASS DISC.

⅛ in. Space Speed.	Pounds Force.	H.P	True Temp. Fahrenheit, degrees.	H.P. corrected to 65° Fahr.
1010	0.23	0.042	66.8	0.043
1212	0.32	0.069	66.8	0.070
1414	0.48	0.121	65.8	0.122
1616	0.63	0.182	65.8	0.183
1818	0.81	0.263	65.8	0.265
2070	1.09	0.403	65.8	0.406
2242	1.30	0.521	65.8	0.525
0.266 in. Space.				
1212	0.44	0.095	67.3	0.097
1313	0.51	0.120	66.8	0.122
1414	0.57	0.144	66.8	0.146
1515	0.66	0.179	66.8	0.182
1616	0.77	0.222	66.8	0.226
1717	0.89	0.273	66.8	0.277
1818	1.01	0.328	66.8	0.333
2020	1.28	0.462	66.8	0.470
2242	1.58	0.635	66.8	0.643

0.535 in. Space. Speed.	Pounds Force.	H.P	True Temp. Fahrenheit, degrees.	H.P. corrected to 65° Fahr.
1111	0.43	0.085	56.8	0.080
1212	0.54	0.117	56.8	0.110
1313	0.64	0.150	56.8	0.141
1414	0.74	0.187	56.8	0.176
1515	0.85	0.230	56.8	0.216
1616	0.96	0.277	56.8	0.260
1717	1.07	0.328	56.8	0.308
1818	1.18	0.383	56.8	0.360
1919	1.30	0.446	56.8	0.419
2020	1.42	0.513	56.8	0.482
3.828 in. Space.				
1212	0.62	0.134	52.8	0.126
1313	0.72	0.169	52.8	0.158
1414	0.82	0.207	52.8	0.194
1515	0.93	0.252	52.8	0.236
1616	1.05	0.303	52.8	0.284
1717	1.15	0.353	52.8	0.331
1818	1.26	0.409	52.8	0.384
1919	1.38	0.474	52.8	0.445
2020	1.49	0.538	52.8	0.504

18 In. Cast Iron Disc (Clean).[1]

3.651 in. Space Speed.	Pounds Force.	H.P.	True Temp. Fahrenheit, degrees.
697	7.35	0.915	59.8
796	9.55	1.36	59.8
896	11.94	1.913	
995	14.68	2.61	
1095	17.38	3.404	
1194	20.71	4.43	
1293	23.58	5.45	64.8
18 in. Cast Iron Disc (Rusted).			
705	9.51	1.198	69.3
806	12.55	1.808	
906	15.55	2.520	
1007	19.43	3.500	
1108	22.53	4.460	72.8
18 in. Cast Iron Disc (With rust cleaned off.)			
705	7.43	0.936	64.8
806	9.68	1.394	
906	12.08	1.956	
1007	14.63	2.635	
1108	17.23	3.415	
1209	19.43	4.20	
1310	22.13	5.18	69.8
12 in. Cast Iron Disc (Clean).			
3.651 in. Space.			
796	1.70	0.242	58.8
896	2.19	0.351	58.8
995	2.69	0.478	58.8
1095	3.17	0.620	58.8
1194	3.82	0.817	58.8
1293	4.42	1.022	58.8
1392	5.47	1.362	58.8
12 in. Cast Iron Disc (Rusted).			
3.651 in. Space.			
705	1.73	0.218	66.8
806	2.33	0.336	66.8
906	2.90	0.470	66.8
1007	3.53	0.636	66.8
1108	4.23	0.839	66.8
1209	5.09	1.100	66.8
1310	5.83	1.365	66.8

[1]We had no time to make tests for our temperature coefficients. Therefore none of these results are corrected to 65 degrees Fahr.

If the corresponding values of horsepower and speed from the above tables are plotted upon logarithmic cross section paper, the points for any given disc and spacing will be found to fall upon one of a series of straight lines, which are substantially parallel. Fig. 2 shows the plot of these points exactly as observed, and corrected for temperature only. If for any given speed and spacing, the horsepower be plotted as a function of disc diameter, the points will be found to fall almost exactly upon a system of parallel lines.

If for given speed and disc diameter, the horsepower be plotted as a function of the spacing, the points will be found to fall approximately upon a system of parallel lines.

These facts indicate that the entire law of power absorbed by friction can be expressed by the relation

$$H.\ P. = Kd^n\ N^m\ S^l$$

Averaging over the entire series of experiments, the following mean values for the coefficient and exponents have been determined:

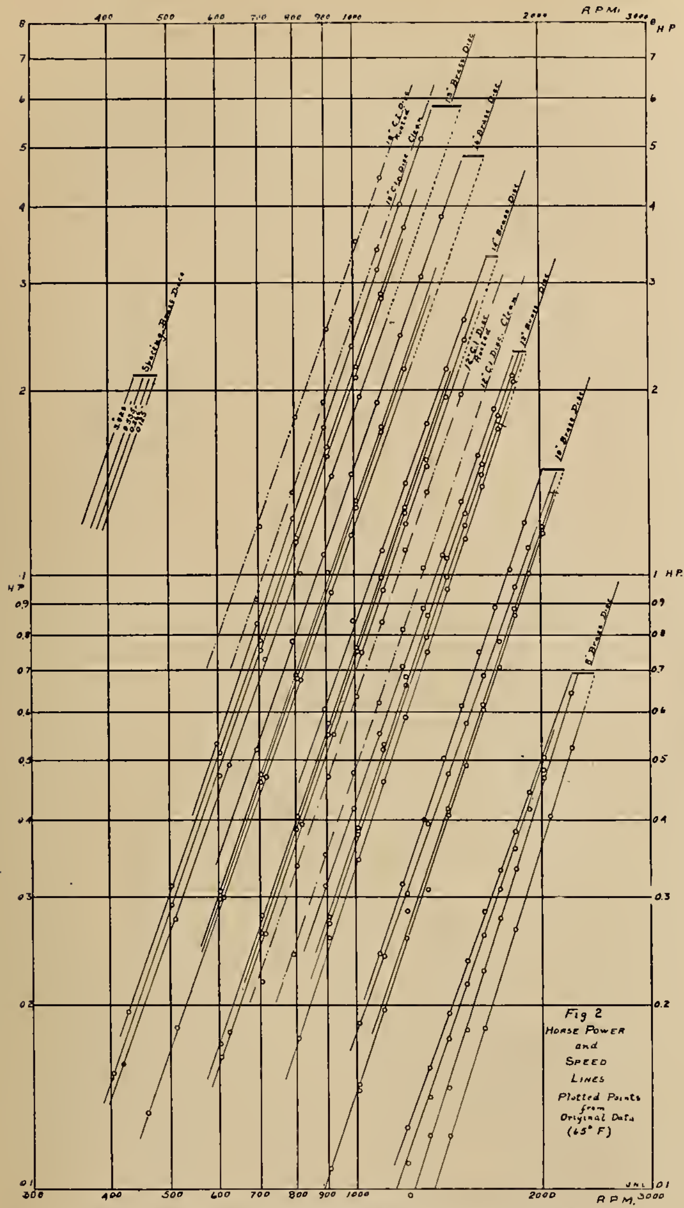

Fig. 2. Horsepower and Speed Lines Plotted From Experimental Data.

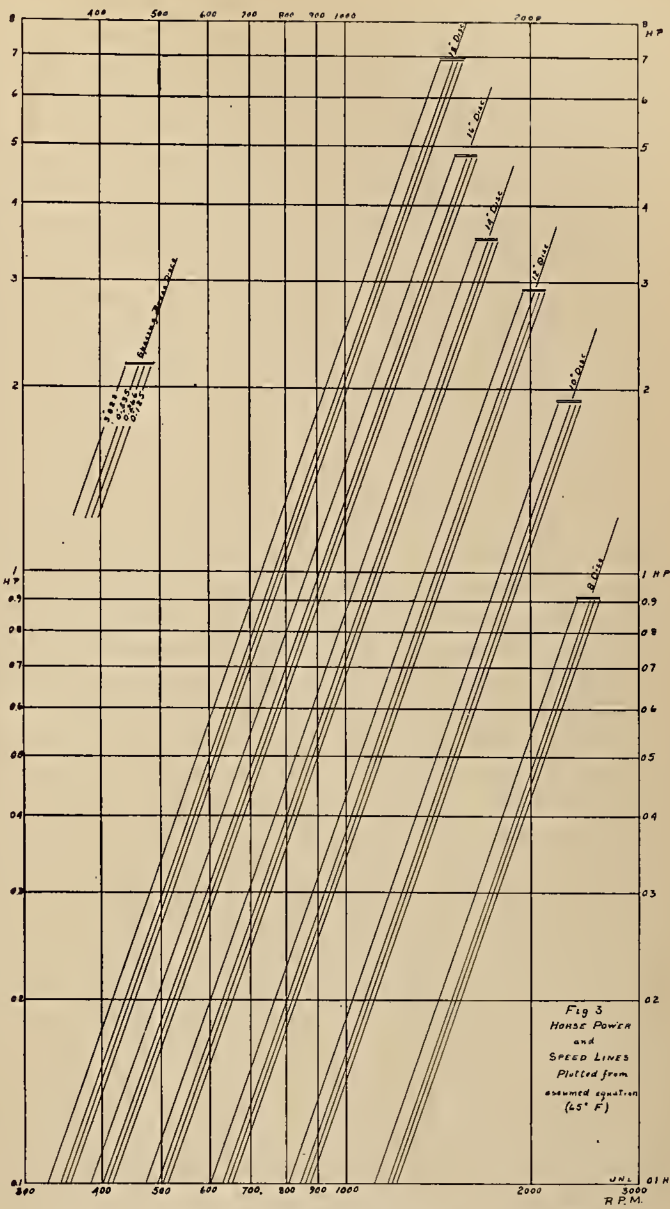

Fig. 3. Horsepower and Speed Lines Plotted From Assumed Equation.

$K = .000,000,000,837$
$n = 4.41$
$m = 2.88$
$l = 0.067$

or $H.P. = .000,000,000,837\ d^{4.41}\ N^{2.88}\ S^{0.067}$
where d is the diameter (virtual) of the disc in feet
N is the number of revolutions per min.
S is the spacing in inches.
(for ordinary machine finished brass discs).

The law which expresses the power as varying with S^1 cannot, of course, be considered as holding except within the range of our experiments. For if $S = O$, then according to the above law the power would be zero, which is contrary to fact. All that is meant here is that the above law seems to hold within the range of these experiments.

Fig. 3 shows the results of plotting the assumed equation with the given values of K, m, n, and l. A comparison with Fig. 2 will give an idea of the accuracy of the assumed equation.

Two cast iron discs 18 in. and 12 in. in diameter and ½ in. thick, and therefore of virtual diamters 18½ and 12½ in. with ordinary machine finish were then tested on the largest spacing. When clean they gave practically the same result as did the brass, the slightly greater power being due principally to the larger virtual diameter. They were then allowed to stand in an atmosphere of wet carbonic acid gas till thoroughly rusted over, and tested again. The rusty iron discs consumed 30 per cent more power than did the clean ones.

If it were merely the sliding or shearing of the rotating disc in the water, and the shearing of the various layers of water upon each other which caused the absorption of power, it would be easy to formulate a theoretic law which would indicate the power to vary as the cube of the speed, the fifth power of the disc diameter, and inversely as the square of the spacing. But this sort of relative motion is clearly not what takes place. Circulating currents are set up which flow outwards along the surface of the rotating disc and inwards along the stationary plates. The intensity of shearing motion increases with the decrease of spacing, but the mass of water set into circulation increases with the increase in spacing and this latter

effect seems to slightly more than offset the former, causing the net absorption of power to increase with increasing spacing. Whether this would hold for very small spacing cannot, of course, be told without further experiment.

In conclusion the writer wishes to acknowledge the valuable assistance and careful work of the following students in the Mechanical Engineering Department, University of California: Mr. H. V. S. Hubbard, who made up the working drawings of the apparatus; Mr. R. H. Beck, who assisted with the testing of the discs in the ⅛ in. space; and particularly Mr. H. F. Fischer, who assisted in all the final testing and computed the results.

LIGNITE FOR FUEL.

North Dakota Lignite as a Fuel for Power-Plant Boilers is the title of Bulletin No. 2 just issued by the Bureau of Mines. This bulletin describes a series of tests at the pumping plant of the United States Reclamation Service at Williston, North Dakota. The Reclamation Service has a large project there and had installed steam boilers with furnaces designed to burn a "brown lignite" that was mined on adjacent government land.

The furnace is of the semi gas-producer type and has an external resemblance to the so-called Dutch oven. The most striking features in its construction are the deep-set grate and the construction of the space between the bridge wall and the end of the prolonged fire brick arch. The furnace is designed to work on the gas-producer principle. The solid fuel is gasified on the grate and the gas passes through the space under the arch into the combustion chamber where most of the gaseous combustible burns.

The results of the tests on the lignite show that this fuel, though generally considered unsatisfactory, may be used with fair economy under boilers that generate their fuel rated capacity. In fact, when the number of heat units available is considered, the results compare favorably with those of better grades of fuel.

The tests are deemed important because the lignite deposits of the Northwest are so extensive and the distance of the region from other coal fields is so great that a large portion of the United States, including parts of North Dakota, South Dakota and Montana, may be greatly benefitted by any improvements in the methods of utilizing this local fuel supply. The lignite in this field is low in heating value, some of it containing nearly 45 per cent of its weight in moisture, and it is difficult to burn in the furnaces commonly used for the better grades of coal, but the tests have shown the possibility of designing suitable furnaces for burning it profitably.

The tests were conducted by the Technologic Branch of the Geological Survey which is now a part of the Bureau of Mines. The authors of the bulletin are D. T. Randall and Henry Kreisinger. The bulletin will be of interest to fuel engineers, especially to those located in lignite territory. It may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

THE PHYSICAL MEANING OF ENTROPY.

BY W. F. DURAND.[1]

The editor has called to my attention the following summary which he has prepared of an explanation of the physical meaning of entropy as advanced by Mr. A. L. Menzin in the Engineering News of September 1, 1910, together with discussion thereon by Sidney A. Reeve and William Kent:

In converting heat into work in a steam or gas engine there is a certain unavoidable waste, or rather transfer of heat energy even in the ideal engine. According to the Carnot principle the greatest amount of work that can be obtained from a quantity of heat Q which is absorbed by the working medium at an absolute temperature of T and the waste heat rejected at a lower temperature T_0 is equal to $\frac{T - T_0}{T} Q$. The least possible waste must therefore be $Q - Q\frac{T - T_0}{T} = \frac{QT - QT - QT_0}{T} = Q\frac{T}{T_0}$

At any instant while this heat is being absorbed an infinitesimal part of it is absorbed at a practically constant temperature T. Denoting this very small amount of heat as dQ the unavoidable waste associated with it is $\frac{T_0}{T}$ dQ and the total unavoidable waste for the total heat Q is equal to the summation of all these elements of waste. Letting L represent this total waste,

$$L = \int_0^Q \frac{T_0}{T} dQ = T_0 \int_0^Q \frac{dQ}{T} \text{ or } \frac{L}{T_0} = \int_0^Q \frac{dQ}{T}$$

But $\int_0^Q \frac{dQ}{T}$ is the mathematical expression called entropy. Hence entropy is the minimum unavoidable heat waste per degree of absolute temperature of rejection.

Mr. Menzin proves mathematically that this definition also applies to refrigeration when the temperature of rejection is higher than the temperature of absorption and also that the entropy remains unchanged when a substance alters its state adiabatically.

From this is derived a more general definition. *In the conversion of heat into work, whether of heat external to a working substance or contained within it as intrinsic energy, entropy is the minimum unavoidable waste per degree of absolute temperature at which all of this waste may be rejected by the working substance.*

Since heat waste is nevertheless heat, the unit of entropy, is one heat unit per degree of temperature as 1 B.t.u. per degree Fahrenheit, 1 calorie per degree Centigrade, etc.

The first serious objection to Mr. Menzin's attempt to give a physical interpretation of entropy is that it is based on a complex or multiple process instead of on a single or simple thermal change. If the concept of entropy is to be of any significance in problems connected with thermodynamics, it must be based on and referable to a single, simple thermal change accompanied in general with a flow of heat into or from the body.

The second objection is that it does not seem to aid very much in clarifying the situation. I doubt very much whether the statement that the "entropy is the minimum unavoidable heat waste per degree of the absolute temperature at which this heat waste is rejected by the working substance" would aid very

[1]Professor of Mechanical Engineering, Leland Stanford, Jr., University.

much in forming a physical concept of entropy, especially in the case of a simple problem such as the following: A pound of air is heated at constant pressure from a temperature of 100 to a temperature of 200 Fah. What is the change in entropy? There is no heat waste involved and nothing in the statement of the problem seems to readily relate itself to Mr. Menzin's definition. Yet it is with reference to such simple thermal changes as this that entropy must be interpreted.

In the original statement by Mr. Menzin, due to the phrasing of the definition, there was some danger of confusion between heat and entropy. This has been removed in large measure by Mr. Kent's discussion, which however does not rescue the definition from the two objections noted. In reference to the definition of the unit of entropy as defined by Mr. Menzin it must be noted that this is no more heat than a rate of pay of $2.00 per day is money. If a man goes into a grocery store to buy $2.00 worth of groceries he cannot pay his bill with $2.00 per day. He can, however, pay with the proceeds of $2.00 per day for one day's time. Thus, rate of pay and time are the two dimensions of money earned, while similarly change of entropy and absolute temperature are the two dimensions of heat flow.

No exception can be taken to Mr. Menzin's discussion in so far as it implies that in a cyclical process, the minimum unavoidable heat waste or minimum rejected heat divided by the absolute temperature of rejection will equal the change of entropy. But, after all this is no more than saying that one side of a rectangle is equal to the area divided by the other, or that one of the two factors of a product is equal to the product divided by the other. The fact is undeniable but it is not easy to derive any basis for a new physical concept or entropy from such statement. Yet this is exactly what is implied by Mr. Menzin's statement and no more. The steps are as follows:

(1) The existence of a reverse or rejection process is assumed and lying between the same limits of entropy as some other forward or heating process under consideration.

(2) It is assumed that this rejection process takes place at a constant temperature, T.

(3) Then by the fundamental concept of entropy or from any of the fundamental equations, it follows that the heat rejected must equal the product of the change of entropy by the absolute temperature.

(4) It follows that the change of entropy will equal the quotient of the heat rejected, divided by the absolute temperature.

(5) This will give the change of entropy backward or for the rejection process, and since the two assumed operations lie between the same limits of entropy, the change backward must equal the change forward.

All these facts are clear and unquestioned, but it is not clear that this imaginary complex process will aid in gathering an idea of the change of entropy for a simple heating or cooling process, such as that involved in the illustrative problem mentioned previously.

This by way of criticism of Mr. Menzin's treatment.

Referring further to attempts on the part of writers like Mr. Menzin and Mr. Reeves to give a physical interpretation to entropy, it would be well if they and all engineers interested would realize once and for all that from the nature of things such attempts must be futile, and that such effort will only result in a labored and backhanded attempt at a physical concept, which will be of small value to either physicists or engineers.

Matter as we know it possesses certain primary characteristics which we can apprehend by our natural senses in a more or less direct manner. Thus, pressure, volume, temperature and energy all present some possibility of direct sensory apprehension, or are related simply and directly to things which may be so apprehended. Unfortunately, however, we have no entropy sense, and cannot come into any direct sense relations with it, nor is it related to other quantities in such manner as to permit of any direct simple physical concept. In brief, it is not a property or characteristic of a substance which admits of direct or first hand apprehension. It is conceivable that a race of beings might be created (and perhaps may now exist on some other planet) which could directly sense the characteristic entropy. It is certain, however, that we cannot, and that all attempt to imagine or define entropy in this manner must end in fog.

Referring now briefly to the subject constructively, we may ask what is entropy and what is the most rational viewpoint for the engineer with regard to its nature.

We may start back with the Clausius equation on which all controversialists will be agreed:

$$\text{Entropy} = \int \frac{dQ}{T}$$

Put into words, this equation simply says that entropy is the sum of a series of small elements, each of which is an element of heat flow divided by the absolute temperature under which such flow is effected. No matter how we may beat about the bush we are not likely to improve on the plain fundamental statement of fact of which this equation is the expression.

On the other hand, there are many helpful analogies. Thus entropy stands in exactly the same relation to heat flow that volume does to the work performed by a body changing volume under pressure. In one case, we have

$$W = \text{Work} = \int P\,dV$$

$$V = \text{Volume} = \int \frac{dW}{P}$$

In the other

$$Q = \text{Heat flow} = \int T\,dN$$

$$N = \text{Entropy} = \int \frac{dQ}{T}$$

This analogy followed out will be helpful to many. Thus, at constant pressure, work is equal to the product of pressure by change of volume. At constant temperature, heat flow is equal to the product of absolute temperature by change of entropy. At constant pressure, the two factors of work are pressure and

change of volume. At constant temperature the two factors of heat flow are absolute temperature and change of entropy. At constant pressure the change of volume equals the work divided by the pressure. At constant temperature, the change of entropy equals heat flow divided by the absolute temperature.

Or again, change of entropy bears the same relation to quantity of heat flow into or from a body that time does to the earning or spending of a sum of money at various rates per day. Thus, a man earns $100 as follows: $10 @ $2.00 per day; $35 @ $1.75 per day; $25.60 @ $1.60 per day and $29.40 at $2.45 per day. What is his time of work? Ans. Time = 10 ÷ 2 + 35 ÷ 1.75 + 25.60 ÷ 1.60 + 29.40 ÷ 2.45 = 5 + 20 + 16 + 12 = 53 days.

A body receives 1000 heat units as follows: 100 at an absolute temperature of 500°; 400 at an absolute temperature of 600°; 300 at an absolute temperature of 450° and 200 at an absolute temperature of 800° What is the change in entropy? Ans. 100 ÷ 400 + 360 ÷ 600 + 280 ÷ 700 + 260 ÷ 520 = .250 + .600 + .400 + .500 = 1.75.

In this sense the number of days' work represents the entropy of a man's earnings. These analogies followed up will be of much help in apprehending the relation of entropy to heat flow and in understanding its usefullness in thermodynamic problems.

From an entirely different viewpoint, we may acquire a somewhat different side light as follows: For a perfect gas (of which air and all the so-called permanent gases represent practical illustration) it is easily shown that the entropy is related to pressure and volume by the following equation:

$$N = C_v \log P + C_p \log V$$

where C_v and C_p are the two specific heats of the gas, one at constant pressure and one at constant volume, while P and V are the pressure and volume. Now we may consider that entropy is simply a secondary or derivative function of the well known characteristics of a body, pressure and volume, and related to them by the above equation, in just the same manner as we may consider area, volume, momentum, moment of inertia and kinetic energy, as secondary or derivative functions of geometrical dimensions and of mass. It might happen that all sorts of secondary functions of pressure and volume or pressure and temperature or temperature and volume might be useful and might require names. Thus, we might imagine a possibility that the ratio P ÷ V for a substance would acquire peculiar interest and call for a name and we might agree to call it Abracadrabra or anything else. Now we cannot readily form a direct physical concept of pressure divided by volume, at least beyond the direct statement as a quotient. Because we cannot, however, there is no need of endowing this ratio or function with anything mysterious or difficult, or of striving against hope to gain a direct physical interpretation of that which has none. We should simply accept it as a secondary function of pressure and volume and be content.

In the same manner, we may accept the preceding equation as simply an equation defining for a perfect gas a function of pressure and volume which is useful for many purposes, and which we agree to call by the name of entropy. The one case is parallel to the other.

For steam we do not have any such simple expression for entropy. Approximately, however, it is represented by the following equation involving temperature and dryness fraction or quality.

$$N = \log_e \frac{T}{492} + X\left(\frac{1435}{T} - .695\right)$$

Where T is the absolute temperature and X the dryness fraction. This may be considered as an approximate expression of relation on the one hand between temperature and dryness fraction or quality (both of which are familiar characteristics) and entropy on the other, which is thus defined as a secondary or derivative function.

In the case of both of these equations it is easy to show in the one case exactly and in the other approximately that they are consistent with the more fundamental relation that for any thermal change

$$N = \int \frac{dQ}{T}$$

This after all I believe to give the best point of view, and if we will simply accept this with its physical interpretation as a summation of small elements each of which is of the nature of a quantity of heat flow divided by the absolute temperatures at which such flow is effected, and accept such side lights and analogies as those mentioned above, we shall rest on sure ground, and shall not invite the fog and haze which must necessarily surround any attempt to consider entropy as a direct physical characteristic, or as capable of any more simple statement in terms of the other characteristics of a substance than that involved in the fundamental defining equation as given above.

ELECTRIC POWER IN MEXICO.

The Central Mexico Light & Power Company, through an affiliated company, has extended its line to San Luis Potosi, transmitting 4000 h.p. from waterfalls in the State of Michoacan. The Central Mexico Light & Power Company, organized in the State of Maine, with a capital of $2,750,000 gold, is controlled by Americans. The company has bought out the local electric company and will supply light and power to various industries. The concession from the State of San Luis Potosi provides that the company shall install a system for the distribution of electricity for purposes of mining, smelting, agriculture, and public works, shall facilitate irrigation when possible, shall encourage the introduction and development of industrial enterprises, and place its electric power at the disposal of the State and municipalities. In exchange the cities will enjoy a reduced rate for current. It is stipulated that the company shall always be regarded as Mexican, subject to the laws of San Luis Potosi, even though the owners may be foreign; that they shall never appeal to foreign law nor make claims through diplomatic channels, under penalty of forfeiture.

THE PROBLEM OF TECHNICAL EDUCATION.

Discussion by members of the San Francisco Section, A. I. E. E., October 28, 1910, of paper by S. B. Charters and W. A. Hillebrand as pubulished in this journal Nov. 12, 1910. The following took part in the discussion:

S. J. Lisberger, Engineer of Distribution, Pacific Gas & Electric Company, Chairman.

C. L. Cory, Professor of Electrical Engineering, University of California.

Harris J. Ryan, Professor of Electrical Engineering, Stanford University.

Orion Brooks, Superintendent Heald's School of Mines and Engineering.

R. W. Van Norden, Consulting Electrical Engineer.

A. H. Halloran, Managing Editor Journal of Electricity, Power and Gas.

K. G. Dunn, Vice-President Hunt, Mirk & Co.

W. A. Hillebrand, Associate Professor of Electrical Engineering, Stanford University.

C. L. Cory: The paper this evening has interested me very much, and I do not know why it should not, because I have been connected with universities and the technical side of the same for about twenty-five years, not only as a student in more than one university, but as an instructor as well in more than one. I have also been in the position of employing and utilizing technical graduates and have been responsible for the character of their work as well as of the men who are not university graduates. In addition, I have been called upon to recommend men for certain positions where the requirements were sometimes specific and in others general.

In the paper this evening there has been presented to us an appeal to the student, as well as to those employing university graduates, asking, first, that the student shall not have a false idea as to what he will really be after he has completed his college course, and second, that those who of necessity employ university graduates may not expect too much of them.

I am convinced to begin with, that in many of our technical educational institutions the instructors connected therewith seem to impress the students with a view point regarding themselves that is absolutely wrong: "A man's a man for a' that." It does not make any real difference whether a young man is educated in the small college or the great university, or gets his education by experience in the world. Results only will count.

Once I had an old colored man working for me, and when I was going away to make quite a long trip and he was driving me to the train, he said: "You know, Mr. Cory, when you're here I know's that you takes all responsibility, but now you's goin' away and I just wants you to know that I's goin' to take that responsibility."

It would be a good thing if all university graduates had the spirit expressed by that old colored man. I find many of them have not. The kind of a man who is worth while is the fellow that will do the thing you expect him to do, whether you are there to tell him how to do it or not, and the technical education as it is given and received in many universities is not such as to impress upon a man that it is his business to do the thing that he is told to do and do it no matter what the difficulties are. That is what the employer wants and what he has a right to expect. He may not get such service from the student the first year of the latter's outside career, but the employer has a perfect right to expect that a college man will see things to do without being specifically told to do them; that he accepts responsibility and will do the thing he is expected to do. I have many times thought of some of the members of my classes at the university something like this:

"You have been sent to the university and now you have nearly completed the course. Some of you have been so unfortunate as to have a fond and devoted parent who has considered it a good thing to take you to some nice summer resort and give you a lazy and pleasant time during your vacation. You have been sent to the university, you did not come. During your college course your first idea was to enjoy yourself. You haven't experienced that thing which is of the greatest importance in the development of character. You never have had responsibility placed upon you, and when you get out into the world you will find that many people who will try to use you will soon find the weakest side of your nature, and they will not care so much what you know as what you can do if left to your own resources."

I have found, and I know many others who have employed university graduates as well as other men have found that it is entirely futile to put responsibility upon a fellow who does not know what it means, and it is not long before one concludes that satisfactory results under such circumstances are impossible.

It has been implied in the paper this evening that the university training only occupies about four years of a student's time, and either before or during this period he may have been handicapped for various reasons. In my opinion it has not been a handicap because he has had to work. That is an advantage. If he has a good mind it is the business of his instructors, both in the preparatory school and in the university, to train that mind and to give him, when he has completed his university work, a mind capable of consistent and accurate work. He should have the ability to analyze a situation and finally come to something like a reasonable conclusion. Such a man will have no difficulty in seeing things in their true perspective, and will do the things that should be done whether somebody has given specific instructions to do them or not.

My experience leads me to the conclusion that the university has the best period of a young man's life. More often than otherwise it is the time when he gets away from certain very delightful but nevertheless sentimental home influences. When he comes to college he finds that he is simply one individual among a great many. He is not spared because he happens to have been more protected than his fellows before he came to college. Perhaps he has been so unfortunate as to possess relatives and friends who think he is a genius. In all probability he is not. He finds he has to work. Fellows at college should at once find this out. As a freshman he will learn many things he never could learn at home. He may learn from a senior, perhaps from a junior, or maybe from a vigorous bunch of sophomores.

It is the task of the instructors in the university to develop this young man, and the instructors have the best chance because he is at this time changing from a youngster into a man, and he should, if he is the right sort of a fellow and has been given the right kind of an example by the university instructors, develop into a keen thinking, healthy, vigorous man. The environment of the university in the class room and out will have much to do with the proper development of such a student.

Referring specifically to the teaching of electrical engineering, I happened to read for the second time a few days ago Professor Sheldon's article which appeared in the April Proceedings of the American Institute of Electrical Engineers, in which he made an appeal for some sort of an institution which should produce leaders in electrical engineering, and he cited the fact that at West Point the government has an institution for the training of young men in military science and that it has not been difficult for that one institution to produce enough leaders to take care of all of the soldiers of the United States Army.

As I read Mr. Sheldon's paper I recalled a story told not long ago by Professor Pritchett in which he described a game of baseball between Harvard and West Point, his son being a member of the Harvard nine. It seems that the Harvard team, on its spring training trip, had been traveling in the South, and naturally having a very lazy and enjoyable time. Their diet had been most carefully prescribed. They had gone South so as to be able to practice in that warmer climate. They had

been under the care of their trainer, who had taken the best of care of them, but behold the result of the game with the soldiers of West Point, who had had not more than half an hour each afternoon to practice. The Harvard team was beautifully skinned. Professor Pritchett thought the reason was because of the discipline and development among the men of West Point. They had not had time to loaf and be entertained by the various college clubs of the South. Perhaps the leadership of West Point graduates may be ascribed to discipline, at least in part.

Our attention has been drawn this evening to the university and its responsibilities, and I for one deplore the fact that in some institutions the student is given a rather bad example by the faculty in the announcement of innumerable one-hour courses, presumably with the idea of giving the impression that the whole field of electrical engineering is completely covered in the college course. In college these courses are soon nick-named "paper courses," and while many of them may be given, yet the real basis of such courses seems to be that of giving the student a certain amount of detailed information about some specific phase of the general course in electrical engineering. Many such courses are unimportant, and I firmly believe that the university and university courses have but one great object, and that is to teach the young men fundamental principles. I doubt the sincerity and am somewhat suspicious of any institution that pretends to give the student a lot of information. I am lead to that conclusion as a result of many discussions with graduates who have been out of their universities not one year but five and even ten years, and from men who have been doing something in the engineering world.

Universities might well give a better example to their students in connection with the method of teaching many engineering courses. I should be just as willing to go to a surgeon and expect that surgeon to successfully perform a capital operation on me if he had studied the science of surgery in a correspondence school only, as to expect some engineering instructors to successfully teach engineering when they have had no knowledge of engineering first hand and no real engineering experience of their own.

In order to be a teacher you have got to know the thing about which you are teaching in such a manner that it is a part of yourself, and such knowledge does not come second hand. Some instructors before a class present matters that they have dug out only a few days before, and such instructors are soon classified by the students about where they belong.

The only way to be a success as an instructor is to inspire the students with the belief that the thing you are trying to help them with is worth while, and as a proper training I would recommend to engineering instructors that instead of standing before a group of young fellows, the difference in age between themselves and the students of each class constantly increasing, that they try the experience of presenting to a board of directors some engineering proposition where he must not only know intimately the facts he is presenting, but must be prepared to prove every statement. He will find the latter job different in many ways than teaching a class. In the end the students can be depended upon to size up the instructor about as well as the board of directors will their engineer.

In our universities we should give to the students every influence that is uplifting and that will tend to make men of them and make them worthy of accepting responsibility, to give them decision and judgment, and in this connection it must be remembered that all that is of value in the university is not confined solely to the class room. There is a general atmosphere around every university which tends to develop the student in one way or the other, and the faculty to a large degree is responsible for the proper kind of this spirit.

Reference was made in the paper this evening as the opinion of one man that no matter how much the university graduate receives he will be overpaid. I do not agree with any such statement. It will naturally depend upon the university graduate. It may be true that he will be paid more than he earns for a short time, but I personally am quite willing to defend the general statement that if the university graduate is of the right sort and is given a chance the employer will find that no matter how much salary he receives he will be under-paid, because his services will be worth more than can possibly be given him in dollars if these services are characterized by a consistant loyalty,. industry and a reasonable degree of originality.

The problem is: what can a university do to develop such desirable characteristics in its graduates? I believe that every university can do a great deal in this direction. One of the first necessities is a thorough confidence and co-operation between the members of the student body and the faculty. Absolute honesty on the part of each toward the other will go a long way toward relieving the present situation and eliminating difficulties unquestionably sometimes existing.

I firmly believe in military science in the instruction of students. It tends to develop characteristics not necessarily brought out in other courses. At the age of the ordinary university student regular military work can not but do him good. Not long ago at luncheon I heard a member of this section say that in the development of character military precision in the child was desirable. He happens to be the chief executive of one of our large corporations, and some one at the table said something of his experience in his youth, and he replied: "Well, I remember our home was a sort of a military proposition. We children were always very happy and we certainly had a joyful time, but there were certain requirements that we lived up to in precise military fashion," and in conclusion he stated that such success as he has had as an executive is largely due to the kind of training he had received from his parents in his early youth.

I personally remember when I wasn't much more than a foot high I used to hear something like this: "Every boy ought to have three things, habits of industry, habits of economy and a good education." These three desirables were the hobby of the best teacher I have ever had the good fortune to know—my own father—and while as a youngster the development of habits of industry and economy and acquiring a good education didn't impress me very favorably at all times, yet now I can see the wisdom of such a trinity, and I am willing to leave it to you this evening if a fellow has really developed the capacity to work effectively, knows how to economize not only in materials and money, but also in time, and has a good education, he is pretty well equipped to be of valuable service to his employer.

If a fellow is working for a corporation and is instructed to get a certain piece of work done at 8 o'clock in the morning, if he doesn't get it done there will be trouble, but on the contrary, in many of our technical institutions if a certain problem is assigned and the work is not completed on time the student will make the excuse that he lost his books, was sick, or some other terrible calamity has overtaken him, with the result that he is given as much time as he likes for the completion of the assigned work. The fellow under such circumstances should kick, because he is not getting the proper discipline to develop him, so that he is going to be worth while to somebody and to make him appreciate to a reasonable degree what is meant by responsibility.

One of the requisites of a good education is the possession of a trained mind and the ability to tie yourself down to some particular piece of work and do that work whether it is pleasant or not. Not that technical education should be a mere grind, because I believe that in engineering institutions every possible incentive should be given to individual and original work. Those of us in the university are delighted to find men, yes, boys even seventeen years of age, who have unquestioned originality, sometimes purely mathematical in tendency, but nevertheless of value to the engineer. In others this originality is manifest in experimental work, and all such men should be encouraged and never discouraged. They should be given every possible oppor-

tunity, and instructors might well remember that in their relations with students certain general characteristics may be reflected sooner or later in their students.

The young college graduate in the large corporation does not have an easy time. The freedom which he has been used to in college he misses, and in its place finds only the rigorous lines of the complete corporation organization, and it often seems the part he has to play is exceedingly unimportant considering the ability which he thinks he has. But I am inclined to think that our universities, which are giving so much attention to the technical work of their students, might do much to remove the criticism that comes from the men who employ university graduates, and this probably can best be done by improving the poin' of view of the students themselves.

In this generation I am inclined to think that many times the parents of a young man desire him to get an education, after having had a hard struggle themselves, so that he will not have to work as hard as they have. Now just as soon as the boy can get that idea out of his mind the better off he is. The more training you have had, and the greater opportunities which you have enjoyed means that the harder you have got to work. It may not be the same sort of work that you would have done if you had not been so fortunate as to have had the opportunity of obtaining an education, but the work you will do will not be according to an eight-hour schedule or the character of work to which you can apply a uniform wage. The hours will be as long as are necessary to do the work, and to do it all in the most loyal manner and use your entire ability with the idea of helping to the maximum the man to whom you are responsible.

Regarding the length of the college course, it is a fact that at the University of California now we have five-year engineering courses and also four-year engineering courses. Not long ago we decided that we would give every student who came to us his choice. He could arrange his work if he chose so as to graduate and obtain a degree in four years. Since this time we have had one young man who graduated from the electrical engineering department who completed all of the courses required for graduation in electrical engineering, and also obtained at the same time a degree in the College of Letters, and all this was done in the four years of work. He entered the university with all the requirements of the College of Letters, and he carried through his university work and graduated as the medalist of his class, and, justly I think, received the two degrees at the same time. It must be admitted that he was a rather extraordinary type of man, but many institutions are recognizing that for a certain type of individual a five-year course is better than a four-year course, and I am inclined to think that the time is not far distant when at the University of California it will be possible for a man to take an engineering course and spend six years in so doing. He will do in that time about the same work that the ordinary student will do in the general culture courses so called, and also it will be possible for him to complete all of the engineering work required in the present four-years course. Such a man, if he is the right sort, should never find a stopping place. He should, I think, by his training be so equipped that it will not make much difference whether his work be of a public nature, that of an executive or exclusively engineering. He will find that he will never be handicapped by a lack of preliminary education. On top of his university work however, must be the broader training of experience, and on the outside he will meet many instructors among his fellows who will teach him many things that he could not learn in any possible manner in the university.

I think when the university which is responsible for the training of its technical graduates finds it necessary to make excuses for its product when they get out into the world, can only blame the training which has been given the students. On the other hand, it is not right that employers should hold the university responsible because their graduates lack a lot of detail information which experience only can give, but if the employer finds that the graduate is deficient in fundamental principles and is also deficient in a desire to be loyal and do his work properly and to work 24 hours a day if necessary to do the thing that has been assigned to him, I am inclined to think that the university is decidedly responsible for the failure of such a young man, providing the university has had entire charge of his work throughout his course, whether it be for a period of four years, or five years or even longer.

Harris J. Ryan: I have read with much interest the paper by my coworkers on technical education. They have given us frankly an instantaneous view of a passing array of related factors that combine to make up the task of the teaching engineer as it exists today. They have made clear that it is proper and right to expect of the college improved results in training the engineer. They have made equally clear that the results which are most desirable can be secured only through the active and cordial co-operation of all concerned: "student, teacher, parent and employer." These results depend not so much upon the normal time required to complete the curriculum, nor upon the contents of that curriculum. They depend much more upon the real spirit of the student and his teachers and what is most important, upon the influence exerted upon the student by his parents, employer and friends.

If the engineering student comes to his graduation with a start in the essential elements of knowing, thinking and doing—if he has acquired a wholesome spirit of "usefulness, activity and co-operation," he will not go into intellectual and working stagnation. He will meet things as he finds them, take hold and make good. Now these are the results that our friends in practice rightly demand. We know that while the quality, character and length of the curriculum are a help when rightly chosen yet they amount to little compared with the fibre of the young man himself. This fibre is the integral result of all factors. Heredity, home and community, school and college, and the early appreciation of the true grit that practical life demands of the successful.

For 22 years more or less the young man has been supported and educated by his parents, friends, community and college. Habits that are long in forming are correspondingly difficult to break, yet the engineer-graduate is asked to break suddenly this deeply rooted habit of dependence upon others for most things. It is a habit that is as old as himself which he must break the first day after his commencement and to substitute therefor the habit of work and discipline that the industrial worker spent eight years to acquire. It is not creditable to our intellects if we expect the engineering graduate to make this transformation in a single day or month and do it well. Better is it, that we should now realize the difficulty we put upon him and help him to meet it. In college we are, in all wholesome ways of which we can conceive, helping the young man from his freshman year to prepare for this transition. You, gentlemen, in practice, can accomplish as much or more in this matter than we can. You can give the college boys vacation work, and work for those who must for a year or more, interrupt their studies to earn their living.

If we could have our own way in these matters we would require of the young man at entrance, that he must have earned his living in a *bona fide* manner for one year.

It is by no means a misfortune to a student when he must drop out for a year to earn his living, especially between his sophomore and junior years. Such an experience tones up his wisdom in a most desirable fashion, though doubtless upon his return for a brief time interferes with his ability to "cram" his work.

We can do nothing better for the cause of technical education than to insist that better results must come largely through a loyal, hearty co-operation of student, teacher, parent, engineering friend and employer.

Orion Brooks: I came here this evening not to speak but to hear what was said; but from the paper that has been read,

and particularly from Professor Cory's remarks, I feel that I ought to say a few words on the subject, and my remarks will be rather those, you might say, of a rank outsider as regards universities.

In order to put myself straight I might say that for about twenty years I was engaged in electrical work, and had occasion to supervise and employ quite a number of people in that work, and I found it extremely difficult to get people who would do the work that was naturally expected of them. It was quite a common thing for parents of young men to appeal to me to take their sons as students in the work room. Now if there is any thing that is an infernal nuisance in a business it is the student; and many times it was rather difficult to say that I would not take them.

Finally the wheels fortunately turned in such a way that I was in circumstances so that I could entertain the proposition to undertake to carry on a plan for giving electrical instruction to young men who could not go to the university for one reason or another, or who would not go (whether they could or not); I took such people, and endeavored to give them the essentials of an electrical education. The first difficulty that I met with, particularly with the average student coming from the grammar school, or from the high school, was that his training so far had been such as to encourage him to lean on some one else. About the first thing that I had to do was to get him to stand on his own feet, to think for himself. He had been accustomed to letting some one think for him. First I made him think for himself, and then started him on the subjects that he wanted to take up—if he knew what he wanted, and very often he did. Some very bright men came under my care; and many of them, I am proud to say, did well.

But the method of instruction and the method of handling them was so entirely different from what I understand is the case in the universities, that you can hardly draw a comparison. Still this one feature crops up above almost everything else—that the young man must be made to stand on his own feet and think for himself; and then it remains for him to determine where he will land, whether it be at the foot of the ladder or at the top. There is no end to the study; and sometimes I have thought that if a person spends four or five or six years in an educational institution he is getting into a line of thought that is going to receive a very severe jar when he gets out and undertakes to make his way in the world. If he gets that jar a little earlier it would perhaps be better for him. Make him stand on his own feet; think for himself; and then point the way to him and see where he will land. That has been my motto.

S. J. Lisberger: Professor Brooks has made one remark that I know more than one of us nodded our heads at, namely, that the student in business is a nuisance. It is quite true that we are very often met by friends, who say, "My boy has been wiring bells around the house, and he thinks he would become a electrical engineer." They give absolutely no thought to what the science of engineering is. They do not know, and the man himself may be far better fitted for a commercial life than for that of an engineer; and the greatest misfortune is that it usually takes him five years to find it out. Then his father thinks he has expended much money in educating him, and he hates to see his boy give it up.

Professor Ryan is quite right when he states there is the duty of co-operation on the part of all concerned, teacher and employer.

I recall a case in my senior year at college that gave more than one young engineer a chance for thought. Our instructor at that time was none other than Professor D. C. Jackson, now president of the Institute. On the first course in alternating currents he spent weeks, if not the whole semester, in drilling into the class the rudiments of alternating currents; and just before examination time he ended up his little course by saying, "We have now read the preface to the book. The rest is merely a novel." He came in examination morning, his hat and coat on, evidently very much in a hurry. "I have to catch a train for Chicago. Will one of you boys write these questions on the board? Deposit your papers Friday. You may use the library. You may talk to each other, and whenever you quote an authority from a book give me the reference. All I ask you is to be honest with me." We spent three or four hours finding out that there was nothing we could learn from books. It was merely a question of think, and you had to think out question No. 1 before you could answer question No. 2, because the answer to question No. 2 depended on the answer to question No. 1. It was a great lesson to all, for it opened our eyes to the fact we had to "think."

R. W. Van Norden: This subject is particularly interesting because, aside from the fact that the paper is an able one, from the professor's point of view. it introduces a sociological subject which is remarkable, in that it has not been more widely discussed. It seems to me that the college point of view of the imparting of a technical education is the constant attempt to solve an abstruse problem, when as a matter of fact, the solution, is extremely simple. It is like a man who has had a break-down with his automobile; he has taken out the carburetor, and then the timer and then spends three or four hours on his back and finally when he gets up he finds that he has the key of the battery switch in his pocket.

Mr. F. V. T. Lee said in a lecture before engineering graduates, that when they went to work at their profession not to be disappointed at receiving but small pay, as they would be worth less than they received, no matter how small it might be.

I do not believe that any college ever has, or ever will, or ever can turn out an electrical engineer. I do not mean to infer by that, that there is anything lacking in the training, because I believe that in order to become an electrical engineer a man must have a college training. But to refer to the example given a moment ago, of the automobile; the college is attempting by every art and device and the most strenuous work on the part of the teachers, to turn out a completed electrical engineer.

It cannot be done. He may, after he has been out a short time, as Professor Cory says, be worth a great deal more than he can command. But he has gotten something that he could not be taught in the class-room, but which the class-room enabled him to attain.

The college discipline and training, with its pursuit of various studies, many at the time seeming to be foreign to the desired object, has given him just one thing—not Ohm's law or certain abstract formulas in mathematics or certain highly theoretical antics of alternating currents, but the ability to think. He has specialized in order to think correctly along specific lines.

I do not approve of many of the methods that are in vogue in imparting technical education, among them I refer particularly to the examination system. But I appreciate that it is a necessary evil. Examinations are necessary to make a portion of the students work. Mr. Lisberger's example of a logical examination illustrates the point.

If a capital operation were to be performed either on a friend to whom I had been intrusted the securing of the services of a surgeon, or upon myself, I would not think of engaging a graduate surgeon, fresh from his college. Neither would I care to have a recently graduated dentist treat an ulcerated tooth. I would employ the best surgeon or the best dentist within my knowledge, that is, the one whom, from a knowledge of his experience, I had the most confidence in.

If, on the other hand, he were not a college graduate, I would not employ him under any condition.

Professor Brooks has remarked that a man must learn to think for himself. This is the same idea in a slightly different form. He must learn in the abstract, how to think, and then he must apply this action, just as a machine is first built to do something that could not be done without the aid of the machine and then the machine must be operated to get the results.

In college, the student does not think for himself; the professor does this for him. He gets ideas and they are gradually lined and connected up for him. He does not appreciate this

until he gets where that line must be put in motion; when he must think for himself.

Some time ago I read an article which was an illustration of the helplessness of the technical graduate in making a simple repair, readily accomplished by a man of practical experience. The latter had worked in a shop four or five years, he had learned how to wind generators and transformers and his skill was unquestioned. He could not have designed the machines and his movements followed certain prescribed rules of practice; these he had learned well. In the illustration, he is given the job of connecting the primary winding of an induction motor. This he does properly as he has done many others. Suppose however that the graduate be given the same job. This motor, let us assume, is different in appearance from the one which he was shown how to connect while in college and it has perhaps been badly burned and otherwise damaged. After having wasted considerable of his employer's time, he will be probably taken off of the job having accomplished nothing. But give him two weeks in the shop, and the technical training will come to his aid; he will figure out the proper manner of connection and will soon be as good a workman as the man who has taken years to learn. That man however, unless he be a genius will stay by his trade indefinitely, but the college man will pass on to something better, until step by step he becomes an engineer in fact.

What then are the qualities required to make an engineer? The untutored, but practical, man says, he must be a practical man. The technical educator says, he must have the theory and the knowledge contained in books and admits that he must have a certain amount of practical knowledge, which he attempts to impart. As a matter of fact, he must have both and yet that is not enough, he must have a third class of learning which seems to be overlooked, or if it is not overlooked it is merged into the other two classes until it often becomes indistinguishable, but it is in reality more valuable toward making the real engineer than either of the other classes.

This quality, I scarcely know how to name, but for want of something better, will call it *psychological*, it is that whereby results are obtained, things are made to go, men are efficiently handled; the application of judgment, common sense, or the discerning ability of knowing how to the right thing at its proper time and of how to use the theoretical and practical knowledge, already received, in doing so.

You have all possibly known of some man, who apparently absorbed the facts taught him in college, who graduated with high academic standing, and who, it may be, took a practical course in the shops of one of the great manufacturing concerns and was therefore, from the ordinarily accepted point of view, a thoroughly equipped engineer. But when it came to making a career as an engineer, even after several years of work and plodding, he failed to more than eke out a bare existance, if he were honest in his work and his dealings toward his clients. The man had all of the practical training necessary and his technical training was as good or better than the rest of his college class. He could not do things, or he did not apply himself aright, or he lacked judgment in every day affairs and failed to get results. He lacked that quality necessary to make an engineer, to do the right thing when something happens.

This ability can be developed, to a lesser extent it is true, in the untrained man, provided it is in his system. I have often told men over whom I had supervision in operating work, that their advancement and welfare did not depend nearly so much on their knowledge of Ohm's law or of how to make an intricate meter connection as on the common sense and judgment in doing the right thing when a series of heavy short circuits come in late, on a stormy night.

That is but an example, but may be multiplied in many ways to illustrate the point. A man who has not had a college education can and will bring out the psychological sense, if it lies dormant within him; if it is not there, it cannot be trained into him through any practical application. If, on the other hand he gets the college training and the method of correctly aligning his thinking, the psychological ability will show itself very quickly when the necessity for it to do so arises, if, as in the other case, it is in his system. If it is not in his system, a certain amount of it can be trained into him, because, he has been taught how to think.

The question of the length of a college course, or rather of lengthening the present course of four years, seems to me not to be as important as some professors deem it. The course depends somewhat upon the temperament of the student. Some students have been known to get through in two years, others take six. It would be manifestly impossible, at least with present methods to have a different course for each student and it would be further impossible to decide what that course should be.

Four years covers the various subjects in a general way and should give the average student the training he is after.

The continuous training in a good many directions should, and I believe does, as a rule, give the average man what he is really after.

The fact that a man does not do brilliant work or cannot get through in four years, is, I believe of far less consequence than it is ordinarily held by educators. The failure to pass examinations or even to absorb many of the abstract facts which are presented to him is by no means an indication of a man's failure as an ultimate engineer. Examination failures, where the student is honest and has put a reasonable amount of thought on his work, seldom indicate the failure to grasp the subject because the students conception may be illustrated in his mind's eye in an entirely different manner from that of his professor. The training is received no matter what else is absorbed and that is what is required.

A return for one or two years of postgraduate work, after one or two years in touch with operating or field conditions would undoubtedly enable the student to get a far greater grasp and understanding of advanced studies than if the work were taken immediately following his graduation.

A technical graduate generally knows, in a hazy way, about what he is going to do to commence on his professional career, but in many cases, probably a majority, he gets into a line of work in which the studies which he pursued with the greatest diligence and the facts and formulas derived therefrom are of no apparent service to him.

There was a technical graduate of my acquaintance, who, when in college made no great records. He was a fair average student but not one for whom his professors predicted an especially brillant future. A year after he graduated he obtained a good position, with an excellent salary for a young man. In another year he was advanced and in a year or so following held a position of great responsibility and was known at home and abroad as an engineer at the top of his profession. Soon after he had his first position, I met and talked with him and the conversation drifted to the subject of college training and I asked the question: "How much of what you learned in college has been of active benefit to you in your business?" His answer was that he had found none of it useful. "Then did any of the examinations for which you crammed cover problems that you meet now?" The answer was in the negative. "You graduated as an electrical engineer, are you following that work now?" "No," was the reply, "I am a civil engineer." "But," I protested, "you learned little or nothing that would specialize you as a civil engineer; how did you get into it; how did you start?" The reply was, "I scarcely know; I was told to survey, examine and report on a great property. I just used my common sense. I had to make a survey and so I bought a couple of standard books on the subject and spent two or three evenings studying them and then it was easy. I set up my transit where the boys would not see it to become more familiar with it and then I went out and told them how to make the survey. I obtained all I needed out of my books, used common sense, made the survey and did it

right and before I knew it, I was chief engineer."

In saying that nothing received at college had benefitted him, he had done his college training a great injustice, because it was that training that had made it possible for him to achieve his remarkable results. Neither theoretical or practical knowledge had helped him, because the former was foreign to his work and the latter he did not possess. But the power of correct thinking had been developed to a high degree.

I have observed many cases of men who in their work and especially examinations, seemed almost stupid, who did not appear to grasp the work or performed it in a perfunctory manner, who apparently seldom listened to what was being told them and who upon entering their career made good, achieved results and were well rated in the profession. This argument would not, of course, apply to the class dunce; there are always a certain number who will either flunk out because they cannot be trained or who will switch to something else. The professors duty is not in trying to wring blood out of a stone but in conscientiously following his work, imparting, so far as he can reasonably do so, the facts and principles to those of his students who are sufficiently interested to listen. The men whose brains are receptive consciously or sub-consciously will derive their mental training just as rapidly as they are able to receive it and no faster.

Finally, I think that Professor Charters admitted my contention, that no college could turn out an electrical engineer, when he said that it was absolutely impossible to give what can be gotten in the industrial world. This is undoubtedly necessary to complete the training.

A. H. Halloron. The gist of Professors Hillebrand and Charters' paper and also of the discussion thereon is well expressed in the following quotation:

"You can lead a horse to water,
But you can't make him drink;
You can send a boy to college,
But you can't make him think."

As intimated by this paper, the college is too heavily debited with the failure of technical men. It may be also added, is too heavily credited for their success. Colleges and college men are inclined to take themselves too seriously.

As a preliminary to a discussion of this subject it is first necessary to come to a common understanding as to what constitutes success—whether it means $u¢¢e$$, or whether it is upon the higher plane of having made the world better by living in it. Most of you will agree however, that when a man's name becomes synonymous with his work, and his work synonymous with his name, he may be considered successful.

To attain this distinction he must know something about everything, and everything about something. This something about which he knows everything is his specialty. A college course affords a brief opportunity to learn a little of the first part of this requirement; but it takes many years after graduation before a man can complete the first, and get a good start on the second.

All that the college can hope to do is to provide him with the tools. A thorough grounding in mathematics, physics, chemistry and drawing will teach him to think clearly, give him the groundwork for more advanced study, and gain him an immediate livelihood if necessary. It is perhaps well to indicate in the last years of a college course the industrial significance of these elements, and give the man a start along some line which he prefers or for which he appears to have some aptitude. With this knowledge and ability he can work out the problems that will come up in practical work, and at the same time will not antagonize his co-workers by the assumption of a superior knowledge.

And last, and most important, a man must be taught how to speak and write correctly, for thereon rests much of his success in getting a position and winning promotion. The preparation of reports, specifications and contracts is one of the most important duties of a successful technical man. Their purpose fails if they are not clearly and concisely written, and there are today many lawyers who gain their livelihood from the mistakes of engineers. English is also the basis of that highest technical education, the study of the classics, which Steinmetz has urged. Finally, how is a man's name to be synonymous with his work in your mind and mine if we do not know the man, simply because he cannot write or talk about what he has done?

K. G. Dunn: This reminds me of a meeting that I attended about sixteen years ago, drawing up the standard specifications of an engineer. One party said that the engineer should be nine-tenths electrical engineer and one-tenth mechanical engineer to make a good electrical engineer. Another party said he would reverse the proportions. The best man would be the man whose education was nine-tenths mechanical and one-tenth electrical; and that struck me as rather funny, so I said the best man was the one who was one-tenth mechânical, one-tenth electrical, and the balance common sense, and if he was endowed with horse sense he would beat everyone of them. Horse sense or judgment is what counts.

On the salary proposition, it also reminds me, I was talking with a well known engineer, and I stated that the majority of people did not get paid in proportion to what they knew; it was more what they did. And he said that applied all right until a man reached the time of life when the people got acquainted with what he thought he knew.

C. L. Cory: I think your story about the examination in electrical engineering given by Professor D. C. Jackson, Mr. Chairman, might with propriety be supplemented by a statement from myself. To begin with, I will start in by saying that at the University of California, as probably some of you personally know, all the examinations in electrical engineering are so arranged that the students have all the books and other sources of information they desire available, and they are told it is perfectly proper for them to get information from any source except one another, and I am inclined to think that at California, as well as Wisconsin, the origin of that sort of an examination was about as follows:

One day in the summer of 1897 Professor Jackson and I were fishing on one of the beautiful lakes near Madison. We did not catch a fish, but we did a deal of talking, and I think that that day we both concluded that if we were called upon to do a piece of engineering work it would be rather hard on us unless we were allowed to do that which we had for a long time been doing, namely, have available all the sources of information which we could get, collect as many facts as possible, and then depend upon ourselves for the proper conclusions. This principle was impressed upon me more firmly not long after that, I think it was during the latter part of the same year. I was requested to make a complete report, stating the reasons why it was not good practice to use 500 volt grounded circuits for ordinary domestic electric lighting. In order to back up certain general propositions which I was ready to defend, it was quite necessary for me to look into the literature on the subject most carefully and obtain as many specific references to the subject as I could find. I worked a number of days on that report, and I think I had as many as fifty books open before me in trying to get together the important opinions and conclusions regarding this particular subject.

I am inclined to think that an examination at college should in a general way represent a piece of work that the student is called upon to do, quite the same as he will have to do when he gets out of the university. Such a piece of work does not necessarily call upon the memory to any degree. To attempt to collect information by memory is abominable. The work of the engineer which is worth while demands the ability to think, to seek out all information and to come to a conclusion after he has carefully collected all the information obtainable, and perhaps the kind of examinations that the men at the University of California get now, as well as the one you ran into as a student, Mr.

Lisberger, at Wisconsin, may have resulted from the fishing trip of Professor Jackson and myself.

W. A. Hillebrand: Mr. Chairman and gentlemen: I am from Missouri. You must show me that a man who is sitting in a class room with his mind principally on a game that is coming off I think two weeks from today, and wondering how big a score Stanford will pile up against California, or the reverse, is getting mental training.

Another point: Mr. Halloran said that a man who has had the preliminary training in mathematics has been trained to think. Now we get these men, get them fresh, and the one thing that stands out prominently above all things is that they are not trained to think; that they can't do it. Professor Ryan and I both agree, that there is really more discipline in a course of logic, or perhaps Latin, than pure mathematics. These make greater demands upon the resources of the student himself and will bring out more latent power than the teaching of mathematics as conducted today, which lays very large emphasis upon mechanical operations. I think it is perfectly legitimate to say that ninety per cent of my time is devoted to an effort to teach men to think.

The problem work in our department comes in in this way: In a course for instance in senior work, the class-room work and the laboratory are run along together. A man studying the characteristics of an alternator is working with it at the same time. By the time his report is finished and handed in, he has hammer him from the laboratory; you must hammer him from the it is a common experience for Mr. Charters and myself to find a man whose mind has not been wandering during the course but who has been paying attention is absolutely ignorant of facts that have been dwelt on in detail in the classroom.

This is not Mr. Van Norden's case—this sub-conscious matter coming in a flash uppermost in his mind; the information that the professor has unloaded upon him bursting upon his vision again. It is not waiting two years or five years, when there might have been an excuse for forgetting. It is a day, or a week, or two or three weeks afterwards, and he knows disconcertingly little about it. You have to give it over and over and over again. You must get at the man inside and out. You must had the benefit of the class work and the laboratory work. Now class-room, and above all in personal interviews when you are discussing your reports with him. A man does not have to be in the teaching business very long before he finds out how surprisingly little of what you try to impart to these people they are able to give back to you. We find it one of the most difficult things in the world to get hold of just what the man really knows, of just how much he has been able to get of what you have endeavored to impart to him. That very question of trying to teach them horse sense—the very question of teaching them to analyze a situation is absolutely the most difficult, the most nerve-racking that is put up to the teacher of engineering today. I have found the final examination to be most profitable along the lines suggested by Mr. Lisberger and Mr. Cory. In the particular examination that I give, I have certain preliminary examinations during the semester; and the man who makes a successful grade, or convinces me that he has done honest and faithful work, is allowed to take this final problem. He is turned loose on it for a week or ten days. He can get any text book; use any of his notes, or anything that he has got, but he is not to consult any other instructor or any of his fellows, but he may come to me. The idea is I want to know how much he has been able to do for himself.

Mr. Lisberger spoke of the young man who had wired bells around the house, and as a result of that wanted to become an electrical engineer. We had a striking example. A man had nearly finished his sophomore year, and during that time he had been put through the ordinary regime, and doubts began to arise in his mind, and he came to us. He figured it this way: He said, "It's all right, but this business of wiring bells don't amount to much. Otherwise I could not have done it. There must be more to this electrical engineering besides this;" and so after we talked the matter over with him he decided to change, and he is going into the hardware business with his father. This I consider a most unusual case—a man interested in his career and what he is going to do, and who really analyzed his own capabilities, his own tastes, and tries to figure out what he can do.

Now we come to the point upon which Mr. Cory laid particular stress, wherein he claimed that the university could do a good deal more than apparently we seem to think, in the way of giving a man discipline. The point of view of the student is admirably illustrated by what one teacher told me a little while ago. He said he was tired of this proposition of procrastination and delay in handing in the work on time; and he made a rule that reports were due on a certain date, and if it were not in on that day it was marked zero, no matter what the scholarship. There was a young man of average ability who protested that that worked a hardship on him. "Well," said the instructor, "suppose in a case at law, that the case came to trial at a certain day, and the report had to be there, what would you do?" "Well," he said, "that is something I would have to do."

It is that point of view that you have to combat. We have much the same requirements at Stanford. Work is due at a certain time. Otherwise it is not considered.

The average age of our entering freshmen is something over twenty years. Suppose you take a man who, throughout those twenty years, has never had to do any one thing with regularity; is it fair to expect the University to equip him with what his father and mother, during the twenty years or so that they had him more or less directly under their care, have not been able to give to him? It it to be expected that the university or individual instructors, who see him three or five times a week, will be able to give him that discipline?

There is a striking example in the case of the San Francisco earthquake. The Stanford students came here to help in the relief after the fire had been put out and things began to settle down. They were generally put on the task of making a house to house canvass to get information as to the number of residents in each house, as affording the Relief Committee a basis for the distribution of supplies. It was an irksome and disagreeable job. The men began to drop out of it one by one just as soon as the novelty was worn off, and soon the allurements of home and vacation and other things drew them away. The gentlemen who had charge of the Stanford Relief Corps said that the men who at last were giving their time to this work were the least able to afford it, men who were working to support themselves. His remarks in the case were significant. He said that these men had learned to stay by a job after it became disagreeable. For instance, if a man is waiting at table he must be there on time three times a day, seven days a week. He is getting disciplinary training. There are certain other men, cradled in the lap of luxury, to use a hackneyed expression, who are willing to submit to that discipline; they expect it, and when the time comes they are willing to submit to it; but I doubt very much if the university can do much for a man who has not already something of it in him, and who has not a point of view that will help him to submit to it when the time comes.

We had some twenty-five or thirty of our students who came up last February to help out on a test of the Great Western Power Company's plant in Oakland. It was rough work. There were six men reading meters, and the others were watching speeds and other things. The hours were long, and they did not like the food that was handed out to them. We heard about it for a long time afterwards. It was an eye-opener. Some of the men who had been doing the best work with us went down when they got up against the real thing. The other men who had had this discipline stayed by it, and were ready to go back again when the time came. There again you have it—the question of discipline—a discipline to your environment, which to our minds, in spite of what Mr. Cory has said, the university can impart only to a limited degree.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

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A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong
604 Mission Street, San Francisco

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Improving Centrifugal Pump Regulation

Though pumping water is one of the oldest uses to which power has been applied, it is still one of the most inefficient. The crude wheel by which the prehistoric Chaldeans irrigated their lands from the waters of the Tigris and Euphrates were but little more wasteful than the modern pump which seldom utilizes more than half of the energy delivered to its prime mover. The tremendous strides that have been made in improving the economy of the steam engine since Watt first used it for pumping water are yet to be duplicated in pumping equipment. The prototypes of both pump and steam engine were rotary machines, which, though long superseded by the reciprocating types, are now being adopted wherever weight of material, space occupied or economy of power are factors, as exemplified in the steam turbine and turbine pump.

The centrifugal is the form of turbine pump in most general use. Its name is derived from the fact that its action is largely due to the variation in pressure produced by the centrifugal force of a quantity of water rapidly rotated by the pump vanes. It is less than ten years since the centrifugal pump was recognized as simply a power turbine reversed, and though it is possible to design a turbine which will operate either as a motor or as a pump, just as dynamo electric machinery is reversible, the greatest efficiency is obtained only by a consideration of the special conditions in each case. Consequently German engineers have been perfecting theoretical designs and American engineers have been developing experimental models from either or both of which a practical pump may be produced with an efficiency approaching that of the turbine. One of the first fallacies that have been disproved by these investigations is the old idea that the centrifugal pump was adapted only to low heads, whereas compound or multi-stage pumps are now designed for almost any head and every service.

Aside from avoidable leaks of water and air, the chief losses in pumps are due to the water's frictional contact within the runner and to its directional changes without the runner. Friction occurs not only between water and castings but also between the eddying water particles. Changes in direction cause counter-currents and eddies whose impact nullify much of the power exerted. As these latter losses are the largest they have rightfully received the greatest attention and have been much reduced by designs providing proper entrance guidance and discharge diffusion. The energy of the discharged water is mostly kinetic and this must be converted into pressure energy for pumping purposes.

Such problems have occupied the attention of most investigators to the exclusion of the frictional losses within the runner. Consequently the exhaustive tests by Prof. Joseph N. Le Conte and his assistants at the University of California are a most notable and acceptable contribution to this subject. As a result of a long series of careful tests an empirical formula has been developed which gives the relation existing between the size and speed of circular pump impellers and the power required, as well as the effect of the size of the chamber in which these discs rotate.

PERSONALS.

Howard E. Pitts is now industrial engineer with the Pacific Gas and Electric Company.

R. G. Hanford of the United Light & Power Co. has returned to San Francisco from New York.

A. G. Wishon, general manager of the San Joaquin Light and Power Company, was at San Francisco from Fresno last week.

W. H. Holabird, who is interested in the Pacific Light and Power Company of Los Angeles, was a San Francisco visitor last week.

Edward L. Brayton, general manager of the Pelton Water Wheel Company, has returned from Southern California to his San Francisco office.

Archie Rice has resigned as head of the publicity department of the Pacific Gas and Electric Company because of serious trouble with his eyes.

George Henry, Jr., chief engineer of the Pelton Water Wheel Company, is in Oregon arranging the details of a new Pelton-Francis turbine installation.

H. W. Turner, president of the Montana Electric Company of Butte, is visiting San Francisco. He is also interested in an electric supply house at Spokane, Wash.

C. R. Ray, who is at the head of an electric light and power system having plants at Medford, Ore., and in Siskiyou County, Cal., spent last Friday at San Francisco.

James H. Wise, of the firm of F. G. Baum & Co., returned last week to his San Francisco office, after making an electrical engineering investigation in Northern California.

E. V. D. Johnson, general manager of the Northern California Power Company, has returned to Redding after spending some days in San Francisco under treatment for a fractured arm.

C. E. Sloan, of Spalding, Sloan & Robson, engineers, returned to San Francisco last Monday after quite a stay in Lassen County, where the firm is fulfilling a contract on an irrigation system.

F. C. Finkle, an electrical engineer of Los Angeles, who has been for years connected with some of the large electric power companies at Los Angeles, arrived at San Francisco during the past week.

R. S. Buck and Wynn Meredith, of Sanderson & Porter, are expected to return to the firm's San Francisco office about December 10th after spending some time in the Pacific Northwest and British Columbia.

Joseph J. Walsh, chief collector for the San Francisco Gas & Electric Co., was suddenly stricken with heart failure on November 19th, thus ending the career of one of the most popular and trusted employees of the company.

R. G. Dugdale, with the Fort Wayne Electric Works of Madison, Wis., and Herbert Duncan, connected with the company's San Francisco office, are making a tour of Northern California in the interests of the new electric rock drills.

J. A. Bumgarner, who is superintendent of construction for the Great Western Power Company, with headquarters at Oroville and jurisdiction from that point up to the hydroelectric plant at Big Bend, spent last Monday at the company's San Francisco office.

Frederick Stearns, of H. M. Byllesby & Co. of Chicago, is at San Francisco on business connected with the formation of Western States Gas & Electric Co., the new holding company just organized to take over the light and power plants now owned and to be acquired by the Byllesby interests in California.

Rudolph W. Van Norden, consulting civil and electrical engineer, has removed his offices to 517 Nevada Bank Building, San Francisco. The Nevada Bank Building was formerly the Union Trust Building, and is the same building in which Mr. Van Norden's offices on the third floor have heretofore been situated.

TRADE NOTE.

The General Electric Company has sold to the McCloud River Lumber Company one A.T.B. 400-kw., 1800-r.p.m., 2300-v., horizontal mixed-pressure, Curtis turbine generator set. It will be installed in the company's mill plant at McCloud. The turbine can be operated either way—at 125 lbs. high pressure, or on the exhaust at 16 lbs. absolute.

Cornelius Nestor, a representative of the Federal Storage Battery Car Company, a concern controlled by Edison and marketing his new storage battery, recently gave a demonstration of the battery at a meeting of the Geary-street Municipal Railway Association. An offer was made to operate a storage battery car on the Geary-street line for one month as a trial. A resolution was passed recommending the Mayor and Supervisors to accept the offer, as the association believes that this style of car is suited for the work.

NEW CATALOGUES.

Bulletin No. 140 from The Bristol Company, Waterbury, Conn., lists all regular lines of Bristol recording pressure and vacuum gauges.

The Engineering and Scientific Activities of the National Electric Lamp Association is the title of the recent bulletin from the Engineering Department of the Association.

Dearborn Drug and Chemical Works have issued an interesting booklet on the subject of Treatment of Boiler Feed Waters which shows their facilities for the special examination of each water sample submitted to them for treatment.

The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has just issued section 3103 of its Perpetual Catalogue 3002-A on the subject of Motor Driven Elevators. The section contains a good many illustrations of typical installations.

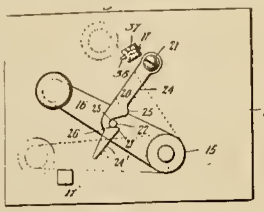
The Pacific States Electric Company of San Francisco, Los Angeles and Portland, announces that their new 1911 catalouge containing 1000 pages, will be ready for distribution early in December. It is of particular interest to central stations, isolated plants, dealers and constructing engineers and will be mailed free to the trade.

S. E. Doane's excellent paper on "High Efficiency Lamps and Their Effect in the Cost of Light to the Central Station" as read at the 1910 convention of the National Electric Light Association has been reprinted for general distribution by the Engineering Department of the National Electric Lamp Association together with several recent editorials in the leading electrical papers.

The Western Electric Company has just received from the press bulletin No. 1014, describing central battery, non-multiple telephone switchboards with magnetic signals. The switchboards presented in this bulletin are those recommended for central battery exchanges where the ultimate number of lines will not exceed 500. In this publication are described the advantages of the magnetic signal board over the lamp signal board. In this type of apparatus the line and cord circuit apparatus and wiring are of similar design and the amount of current consumed is slightly less than that consumed by the lamp signal board. The bulletin contains a description of the signals, jacks, circuits, and apparatus in this line of switchboards, going thoroughly into details. It is well illustrated with photographs, diagrams and tabulations.

PATENTS

976,422. **Electric Switch.** John Hastings Wooll, San Francisco, Cal. A motor starting switch having two positions, one the starting position and the other the running position, the movable switch parts being movable by gravity unrestrainedly downward from said starting position to said running position, a latch cooperating with said switch to hold

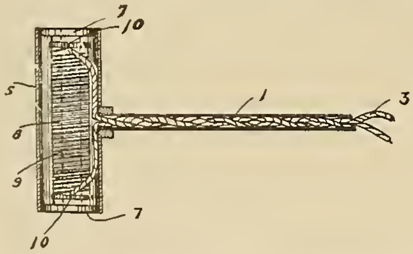


it normally in an intermediate position, but ineffective when the switch is allowed to fall from the starting to the running position, said switch being free from restraint when so moving, and lugs for limiting the movement of said switch parts, one of said lugs also serving to limit the movement of said latch.

976,404. **Electrical Heater.** Milton H. Shoenberg and George T. Marsh, San Francisco, Cal., assignors to Appliance and Electric Device Company. An electrical heating element consisting of a single conducting core of solid metal, a conducting resistance coil wound about said core, an insulating

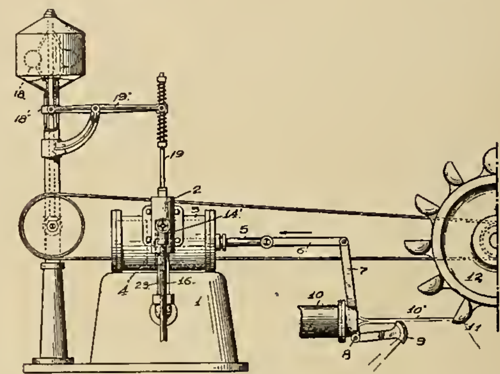
medium interposed between the core and coil, an insulation inclosing the coil, an exterior closed seamless tube flattened and compressed upon the outside of the exterior insulation, said resistance coil being connected at one end with the core and at the other end with an electrical terminal, said core having a connection with a similar terminal.

976,405. **Electric Heater.** Milton H. Shoenberg, San Francisco, Cal., assignor to The Presto Electrical Manufacturing Company. An electric heater comprising a casing open



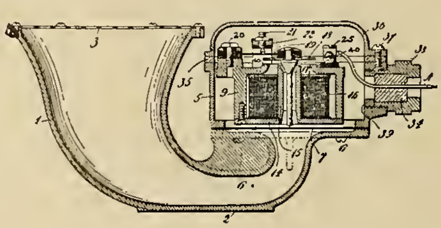
at both ends, a tubular handle secured thereto and extending at right angles therefrom, a tubular spool within said casing having both ends open and registering with the ends of the casing, the cavity between the spool and casing being closed at both ends, a high resistance wire upon said spool within said cavity, an insulating medium separating said wire from the spool, and conducting wires passing through said handle and connected to the resistance wire.

976,174. **Standardizing Device for Governors.** George J. Henry, Jr., San Francisco, Cal., assignor of one-half to The Pelton Water Wheel Company. The combination with a pressure cylinder, a fluid actuated piston working therein, for regulating the quantity of an impact stream issuing from a nozzle relative to a hydraulic motor, means thrown into action by the movement of the piston for varying the water



quantity of the impact stream relative to the driven motor to proportion the same to load variations, mechanism for supplying fluid under pressure to the pressure cylinder for moving the piston inwardly and outwardly, and means for reversing the flow of the fluid under pressure relative to the pressure cylinder to vary the movement of the piston working therein.

976,159. **Electrically-Operated Signaling Horn.** Egmont Max Tormin, Newton, Mass., assignor to Holtzer-Cabot Electric Company, Brookline, Mass. An electrically-operated signaling-horn comprising in combination a horn, a casing secured to the inner end thereof, a diaphragm interposed between said horn and casing, an electromagnet having a hollow



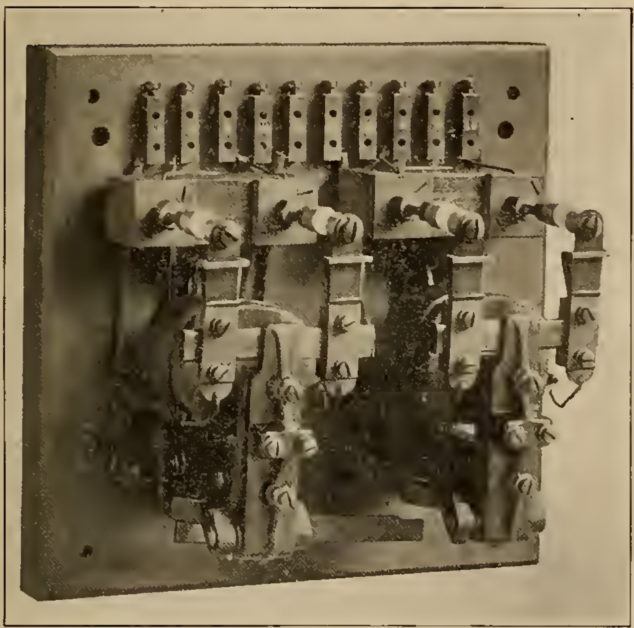
core, a plunger arranged within said core and having one end normally adjacent to, but not in contact with said diaphragm, a resilient supporting-member secured to the other end of said plunger, a circuit including the coil or said electro-magnet, means whereby said circuit may be automatically opened and closed, and means surrounding said hollow core and connected to said circuit for preventing sparking when said circuit is opened.

INDUSTRIAL

WESTINGHOUSE COMPANY BRINGS OUT NEW RELAY.

The Westinghouse Electric & Manufacturing Company has just brought out an entirely new design of the secondary or auxiliary relay for its induction regulators. The new relay is a radical departure from former types. It embodies several features that have been found desirable in this class of apparatus by the Westinghouse Company. These features insure excellent performance and long life.

The new relay is of the dry type, while the former was oil-immersed. The non-inductive resistance that was used in the old-style relay is used with the new style, but is now built as a primary part of the relay instead. This resistance, permanently connected across the contacts, absorbs the inductive discharge of the coils at the moment of breaking of contact, and assists in the elimination of sparking.



Relay for Voltage Regulator.

As all the wearing parts used in the new relay are case hardened it is very durable. In fact, the relay has been designed as a continually operating, hard service mechanism instead of as an instrument. The use of nickel for the relay contacts is a marked advancement, as it gives all the advantages of platinum, at a cost for renewals that is negligible. The result obtained from the operation of motor-operated regulators by means of this relay have been very satisfactory. The wear on the contacts is so slight that the adjustment and renewal of contacts is reduced to a minimum. When necessary, however, this adjustment or renewal can be very easily effected.

A feeder regulator will pay its cost in a short time by maintaining the voltage at a constant point. Close voltage regulation causes a decrease of lamp renewals, an increase in the sale of energy, an increased feeder capacity, and a higher economy of operation of the system; it helps greatly in making the customers satisfied with the illumination and service.

Central station managers now fully appreciate the economy to be effected by use of feeder regulators, and are rapidly taking them up. Formerly some mechanical troubles have been encountered in these, but, in their present state, Westinghouse regulators are practically as reliable as the static transformer.

A NEW TYPE RECTIFIER OUTFIT.

The mercury arc rectifier provides a convenient and efficient means of transforming alternating current to direct current and is meeting with a wide application in this field.

This device is used extensively to charge the batteries of electric automobiles, and the General Electric Company's universal battery charging rectifier outfit has met with great favor. It is complete with voltmeter, ammeter, and protective devices and is designed that it is suitable for a wide range of voltages and for current capacities ranging from 10 to 50 amperes.

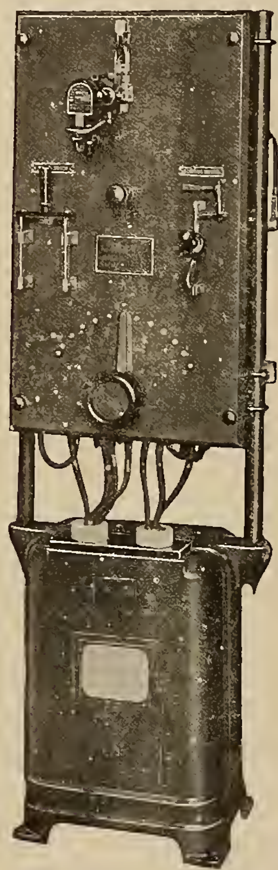


Fig. 1. Battery charging single phase mercury arc rectifier (front of panel).

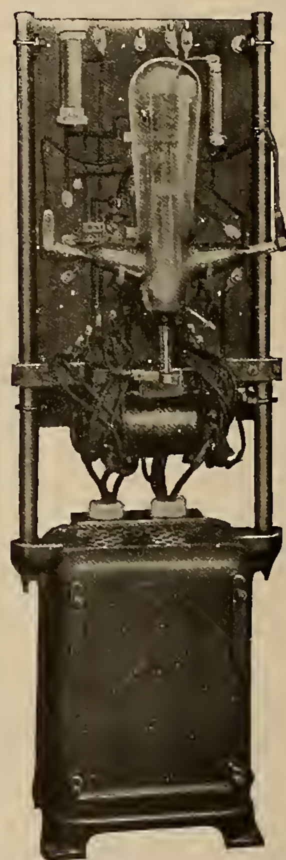


Fig. 2. Battery charging single phase mercury arc rectifier (back of panel).

To meet the demand for a less elaborate panel, the General Electric Company has recently placed on the market a rectifier designated as the "runabout type." This new rectifier is made up without voltmeter or ammeter. It is, therefore, recommended only for use with cars that are equipped with a first-class voltmeter and ammeter. It is designed to charge batteries consisting of from 20 to 32 cells at a maximum charging rate of 30 amperes.

The "runabout type" rectifier has one important advantage over the universal type—its extreme simplicity. As will be noted above, its range is limited to 20-32 cells, while the universal type will charge from 5-44 cells of lead plate battery. Therefore the former does not require special and elaborate means of adjusting current and voltages. It has only one small dial switch which gives a range of fine regulation sufficient for any battery from 20-32 cells. This means a simplicity not possessed by any other battery charging rectifier set and will make the set appeal to the many men and women who want to charge their own electrics but perhaps

hesitate to tackle the slightly more complicated appearing universal type.

Figs 1 and 2 show front and rear views of the new rectifier. This outfit is self supporting. The panel pipe supports are screwed into suitable receptacles on the compensating reactance which is of sufficient weight to hold up the rectifier panel and its equipment.

The outfit consists of four essential parts, rectifier tube, compensating reactance, regulating reactance and panel with supports.

The rectifier tube is an exhausted glass vessel that contains mercury. It has four electrical contacts (see wiring diagram "A," "A," the working anodes, "B" the cathode and "C" the starting anode.

The tube is mounted in a holder on the back of the panel. The shaft of the holder extends through the panel and is connected to a hand wheel ou the front, by means of which the tube is tilted when starting the outfit. Fig. 2, which shows the back view of the rectifier panel, illustrates the form of the tube holder. Particular attention is called to its simplicity and to the evident case with which a tube can be inserted.

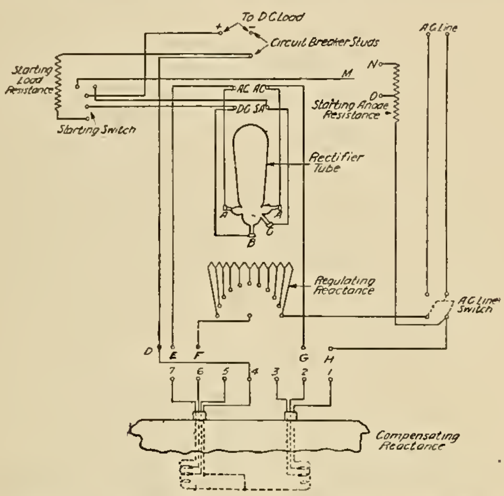


Fig. 3. Connections of single phase rectifier.

The function of the compensating reactance is to maintain the arc in the tube while the alternating current is passing through the zero point of the cycle. This reactance is so arranged that one lead is a negative pole of the rectified current while the other leads are arranged so that the reactance can be used as a compensator (thus its name, compensating reactance) so that by a few changes the outfit can be used on either 110 volts or 220 volts a. c. supply circuits and be able to charge a maximum of thirty-two cells.

Fine regulation of the direct current voltage is accomplished by means of a regulating reactance which is connected in the a. c. line. This reactance consists of a coil wound upon one leg of a rectangular laminated core. The coil has eleven taps, which are connected to studs on a dial switch mounted on the front of the rectifier panel.

The rectifier panel is of natural black slate 28 in. x 16 in. x 1½ in. and it is equipped with all switches necessary for the operation of the rectifier and the regulation of the charging current.

This simple, compact and inexpensive rectifier outfit will be found to be satisfactory in every respect for charging electric runabouts and other electric vehicles that have about the same number of cells and no doubt it will come into extended use in this connection.

ADAMS-BAGNALL ACQUIRES JANDUS.

Adams-Bagnall Electric Company of Cleveland, Ohio, has purchased the good will and assets of the Jandus Electric Company, Cleveland, Ohio. The Adams-Bagnall Electric Company will continue the manufacture of Jandus products and will exploit them under the trade name "Jandus," for example, Jandus fans, Jandus Luxolabra, etc. The Adams-Bagnall Electric Company has associated with it the former management of both the commercial and engineering department of the Jandus Electric Company. With the largely increased capital and extended facilities with which the business will in the future be conducted, the patrons of the Jandus Electric Company will find a greatly increased efficiency in meeting the demands of the trade.

RAILROADS OF NEW ENGLAND FAVOR TELEPHONE METHOD.

Railroads operating through New England have been among the leaders in the movement to replace the use of the telegraph with the telephone for the work of dispatching trains. The new method has been found satisfactory on a great many trunk lines of the country, and has many advantages in the way of accuracy, speed and safety.

The New York, New Haven and Hartford already has in operation telephone circuits covering 100 miles of its road from Northampton to New Haven, with branches to Holyoke and New Hartford. There are twenty-nine telephone stations on this division, which is equipped with test panels, selectors and flexiphones.

Sixty-eight stations are in operation on the Boston & Maine, covering the White Mountain division and the Concord division. These circuits extend from Concord to Woodside, 93 miles, White River Junction to Concord, 70 miles, and Boston to Fitchburg, 50 miles. The best grade of copper wire is being used, together with telephone arms, selectors, wrecking outfits and portable sets.

The Central Vermont has just ordered telephone equipment to cover its northern division from St. Albans to Windsor, Vermont. On this stretch of 150 miles there will be 38 telephone stations, which will be equipped with telephone arms and circular loom cable.

The Boston & Albany already has in successful operation telephone equipment covering the whole of its main line and all branches from Boston to Albany. On these four circuits, extending 390 miles, there are 165 stations.

The equipment of these railroads was furnished by the Western Electric Company, which has supplied more than 90 per cent of the railway telephone equipment now in use in this couutry. Other railroads are using the telephone for this service as far west as the Pacific coast and south as far as Florida aud Texas.

WESTINGHOUSE HAND OPERATED UNIT SWITCH CONTROL.

The new Westinghouse hand operated unit switch control is attracting much interest and favorable comment among railway men. The company made this control an attractive feature in its exhibit at the Atlantic City Convention and has just issued a complete circular descriptive of the system. The trial Westinghouse HL equipment installed last April for the Fort Wayne & Wabash Valley Traction Company has proven so successful that an additional order for the same apparatus has now been placed and its satisfactory on this line has been a factor in several orders from the same vicinity.

A similar result followed the initial installation of this control on the Mahoning and Shenango Valley and Fairmont & Clarksburg lines, both companies ordering additional equipments after thoroughly testing the system in service. Recent orders placed with the Westinghouse Company for this HL control include equipments for the following roads: Ohio Electric Company, Illinois Traction Company, Peoria Railway & Terminal Company, Winona Interurban Railway Company, Indiana Union Traction Company, Alton, Jacksonville & Peoria Ry.

NEWS NOTES

INCORPORATIONS.

PAYETTE, IDAHO.—The Salmon Falls Light & Power Company, capital $100,000, has been incorporated by A. E. Wright, J. M. Swanson, W. C. Sturtevant, all of this place, to engage in general light and power business, to own and operate flour mills, sawmills and planing mills.

LOS ANGELES, CAL.—The Southern California Gas Company has been incorporated as a successor to the Domestic Gas Company and as a subsidiary of the Pacific Light and Power Corporation, by A. C. Johnston, Charles Foreman, E. R. Davis, A. N. Kemp and H. Baumgartner. A 10-inch high-pressure gas system is to be installed from Los Angeles to Pomona, with branch mains to all intermediate towns. From Pomona, where a distributing system is to be installed, a six-inch pipe line will run to San Bernardino, supplying other cities on the way. The plant at San Bernardino will be shut down and used only as an auxiliary station and smaller pressure lines will care for the country south and east of that point. Work on the San Bernardino construction will begin shortly after the first of the year.

FINANCIAL.

CENTRALIA, WASH.—Voters of this city will decide upon issuing $300,000 of bonds to pay for the system at a special election in November.

ASHLAND, CAL.—The City Council has approved and accepted the report of the Engineer, W. J. Roberts for the reconstruction of the municipal water plant and directed the recorder to proceed with the necessary steps to place the subject before the voters. The Council now has authority to issue $27,000 water works bonds and the bond election will be to authorize $143,000 more, making the sum of $170,000. The engineer's report estimates the cost at $160,103. It recommends two reservoirs of a combined capacity of 5,000,000 gallons of water.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Northern California Power Company, held at San Francisco, November 23, President H. H. Noble made a favorable report as to the operations for the fiscal year ended Oct. 31, 1910: The following synopsis of the financial showing was included: 'The gross earnings of our corporation for the past year yere $578,082.37, which is a gain of $145,367.32 over that of the previous year. After paying all operating expenses and taxes our net earnings amounted to $406,834.39, which is an increase of $137,553.30 over the net earnings of the previous year. We have paid $210,000 in dividends and have added to our surplus $74,008.46 from the year's operations."

TRANSMISSION.

ONTARIO, CAL.—The stockholders of the San Antonio Water Company have decided to increase the power capacity of sub-station No. 1, the cost not to exceed $20,000.

WALLA WALLA, WASH.—W. B. Forshay, manager of the Pacific Light & Power Company, announces that the flooded power plant on the Walla Walla will not be abandoned. New electrical machinery will be installed.

BELLINGHAM, WASH.—City Engineer H. A. Whitney is advocating the proposition of the establishment of a $200,000 municipal electric power plant, and a flume. The plan can be carried out as soon as the city decides on the issuance of bonds.

REDMOND, ORE.—C. M. Redfield of the Deschutes Irrigation & Power Company, states that the receiver's sale has been approved by the court and that the reorganized company is ready to go ahead with construction work of the North canal.

NORTH YAKIMA, WASH.—Extension is to be undertaken at once by the Pacific Power & Light Company for taking its power lines through the Selah and Wenas valleys for the purpose of aiding ranchers who may desire electricity for irrigation purposes.

SPRINGFIELD, ORE.—The Northern Idaho & Montana Power Company has purchased from V. N. Sutton, a lot in Kelly's Addition to Springfield, the consideration being $100 per foot or $3300. The plan is to erect at Springfield a general sub-station and make this place a distributing point of power for the entire Willamette Valley. The company will at once commence the erection of a two-story brick building on the lot and it is to be ready for occupancy in February or March. The machinery alone to be installed will cost $150,000.

TRANSPORTATION.

MARTINEZ, CAL.—The first rail on the Oakland-Antioch electric railroad was laid last week at Bay Point, when workmen commenced the actual construction of the new line.

SPOKANE, WASH.—The Spokane, Portland & Northern Railway will start work on the construction of an electric line from this place to Davenport, Wash., about the first of the year.

OAKLAND, CAL.—The auditing and finance committee has reported that the application of the Oakland Traction Company for a franchise to operate a street railroad on Ninth avenue be granted.

LOS ANGELES, CAL.—Arrangements have been made by the Southern Pacific Railroad Co. to electrify its 170 miles of track between Los Angeles and Bakersfield. This transformation is to be completed by January 1, 1912.

FRESNO, CAL.—The project of S. N. Griffith for an interurban electric railroad between Fresno & Clovis took tangible form in an application made last week to the city trustees for a franchise to lay tracks within the city limits.

SAN RAFAEL, CAL.—A street railway franchise has been sold to George D. Shearer for $350. The franchise covers the principal streets in this city and stipulates that work on the road shall commence within three months and be completed within two years.

THE DALLES, ORE.—E. W. Thomas, who has a franchise for an electric railway system here, has started building operations. The road will reach all parts of the city and be extended into the country in every direction. Frank P. Phillips has the contract.

SALEM, ORE.—One of the important bills that will in all probability be brought up before the council for their consideration will be a bill for an ordinance granting to the Santiam Development Company a franchise over certain streets in this city. It is the purpose of the Santiam Development Company to construct an electric railway line between this city and Stayton and in the bill before the Council state that said line will be in operation within two years from the passage of the bill.

FRESNO, CAL.—The Fresno Traction Company is considering an extension of its lines to Mountain View cemetery by way of Forthcamp and Olive avenues. Superintendent F. W. Webster states that the line had been mapped out and the project approved. The matter now rests with the finance committee of the directors.

BELLINGHAM, WASH.—A $2,000,000 bond issue is back of the Nooksack Valley Traction Company, which plans to build a 60-mile road in Whatcom county. The bonds will pay 6 per cent interest and be for 30 years. Vice-president Morrison states that the first piece of road to be built will be between the Guide Meridian road or Meridian street and the junction of the Marietta road with the Great Northern. The contract will be let in a few weeks.

SAN FRANCISCO, CAL.—The Good Government League, has filed with the Board of Supervisors a long petition setting forth the alleged inadaquate service furnished by the United Railroads to the people of San Francisco, and calling on the Supervisors to enact an ordinance that will give relief by providing a seat for each passenger and other requested improvements. The allegation is made that persons desiring to live in San Francisco are driven to the other bay cities, "it being less inconvenient in these particulars than a residence in this city."

SAN FRANCISCO, CAL.—Judge Seawell has rendered a decision in the case of the people of the State against the Sutter Street Railway Company and the United Railroads an action to declare forfeited the franchise governing the use of the outside railroad tracks on lower market street between Sansome street and the Ferry building. Under the decision of Judge Seawell, which was on demurrers filed by the defendants, the main fight between the city and the railroad companies involved to gain possession of the tracks will be between the plaintiff and the Sutter Street Railway Company, the original holder of the franchise. The United Railroads will not figure as an active defendant.

ILLUMINATION.

RICHMOND, CAL.—The Council has adopted the ordinance granting the Great Western Power Company a franchise to operate a power and electric lighting system in the streets of the city by the erection of poles and the stringing of wires.

RICHMOND, CAL.—A modern electric-lighting system with all modern improvements is the next innovation planned for this city. Manager H. B. Kinney of the Richmond Light & Power Company announces that he has received instructions from headquarters for the complete reconstruction of the plant.

LEWISTON, IDAHO.—Announcement was made at the special session of the City Council by General Manager Philbrick of the Lewiston-Clarkston Improvement Company that a contract has been let to Chas. C. Moore & Co. of San Francisco and the General Electric Company for the installation of a new steam power electric plant in Clarkston to cost $100,000.

OAKLAND, CAL.—Negotiations are pending for the absorption by the Pacific Gas & Electric Company of the Suburban Light & Power Company. The announcement of the proposed deal follows closely upon the closing of the deal by which the Pacific company will hereafter distribute the output of the Great Western Power Company. The Suburban company's holdings are estimated to be worth in the neighborhood of $1,000,000 and the company supplies light and power to Haywards, San Leandro, Niles, Irvington, Newark, Elmhurst, San Lorenzo, Pleasanton and other Alameda county towns. John A. Britton of the Pacific Company admits that his company is planning to absorb the Suburban company, and says he expects the deal to be consummated before the first of the year.

BAKERSFIELD, CAL.—The Bakersfield Electric and Gas Company, which is a subsidiary company of the San Joaquin Light and Power Company, has signed a contract with the California Natural Gas Company for the supplying of the city of Bakersfield with natural gas. The gas well of the company is located in the Midway field, and pipe lines from it are already laid to within eight miles of the city of Bakersfield. It is expected that the connection will be completed within three weeks.

WATERWORKS.

TRACY, CAL.—Frederick C. Roberts, of San Francisco, has applied for a franchise to install a water system here.

PORTLAND, ORE.—Woodstock, Woodmere and Rose City Parks are preparing to ask the Water Board for larger water mains, which will insure enough water for fire protection.

OAKLAND, CAL.—It is believed that F. M. Smith is about to acquire a large holding in the Bay Cities Water Company. Mr. Smith was formerly heavily interested in the Peoples Water Company.

RED BLUFF, CAL.—Charles L. Crowder has filed an appropriation of 7000 inches of water in Deer creek to be used for the generation of power for commercial purposes. The point of diverting the water is about 15 miles southeast of Red Bluff.

WALLA WALLA, WASH.—Bids will be received by the city of Walla Walla at the water office up to 2 p. m., December 1 for furnishing six thousand feet of 20-inch waterpipe, more or less, f. o. b. Walla Walla. The bids are to be received on both iron and wood pipe. Iron details must be given, such as weight of pipe per foot, style of joints, etc.

FLAGSTAFF, ARIZ.—The city of Flagstaff and the Santa Fe Co. are about to agree over the ownership and use of Great Springs on the San Francisco mountains, from which Flagstaff is supplied with water. Attorney Capp of Los Angeles has proposed for the railroad company to surrender all claim upon the springs and to loan the municipality $92,000 necessary to build a storage reservoir and the money to draw 5 per cent, the city agreeing to sell 200,000 gallons daily to the company at a price that shall be mutually agreeable. It has been estimated that the springs have a flow of 700,000 gallons a day.

NORTH YAKIMA, WASH.—Geo. C. Arrowsmith of the Pacific Power & Light Company received orders from the head office of the company to proceed at once with the work of the extension of the present water main from the point where it enters the river, about 13 miles above the city to the reservoir at the end of the power canal, which is situated two miles further up the river and about 150 feet higher. The cost of the installation will be $32,000.

SAN JOSE, CAL.—A communication has been received from F. G. Volkers, City Plumbing Inspector, asking that the water company be required to extend its mains so as to supply water as follows: On Fourteenth street from Empire to the northerly city limits; on Eleventh street from Jackson to Taylor; on Vine street, from Grant to West Virginia; on Humboldt street from Mastick to Plum; on Mastick street from Humboldt to Floyd.

TELEPHONE AND TELEGRAPH.

SACRAMENTO, CAL.—The Home Telephone Company is to invade the Sacramento field. Plans are now being laid to get the business and install a plant. Representatives of the company have been here for several days and everything is ready for active work. The attorneys for the new company are now drawing up a franchise and the City Trustees will be asked at the next meeting to grant it.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 24 SAN FRANCISCO, DECEMBER 10, 1910 PER COPY, 10 CENTS

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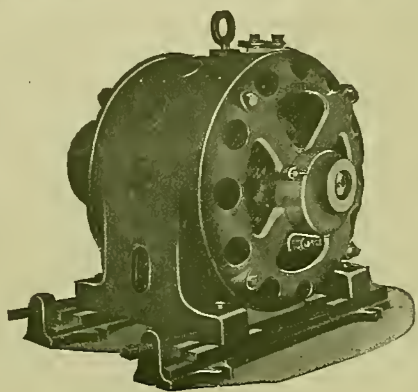


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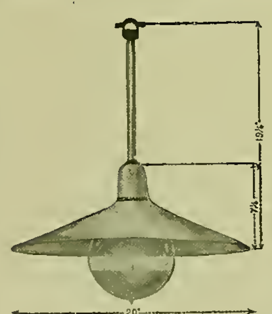


JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXV SAN FRANCISCO, DECEMBER 10, 1910 NUMBER 24

PROSPECTS OF NEW PRODUCTION OF GAS MAKING OILS[1]

BY P. W. PRUTZMAN.

In these days, when practically all city gas is made from petroleum, a knowledge of the available supplies of this material, and of the prospects for future production and for fluctuation in price, are of considerable importance to the gas-maker. This will be my apology for a paper which must, from its very nature, be hard reading.

Petroleum has long been known to exist in California, and has been produced in commercial quantities for more than thirty years. But for a long time so small was the production that, so late as 1899, Peruvian oil or distillate was still being imported for gas-making purposes, and the price of local products made them a luxury.

During the twelve years past, the search for new deposits has been carried on actively in almost all parts of the State, with the result that California has been carried from the seventh or eighth position to that of by far the largest producer, and our oil fields now yield more petroleum annually than any similar area in the world. The output for the current year bids fair to reach a total not far from eighty millions of barrels, as against perhaps fifty millions for the combined Russian fields, and about thirty millions for the Kansas-Oklahoma field, our nearest competitor in the United States. Yet strangely enough, this enormous production is taken almost entirely from seven small areas, the total surface covered being considerably less than that of San Mateo, one of our smallest counties.

The following tables show the production for 1909 by counties, and by fields. In this table, 20 degrees Beaume is taken as the lowest limit for refining oils, and the estimated output of oils over and under this figure stated for each field. Table 3 shows the production for the month of July, 1910, by fields.

Oil Pumping Rigs in Coalinga Field

TABLE 1.

PRODUCTION OF PETROLEUM, BY COUNTIES.

FOR THE YEAR 1909.

County.	Fields.	Barrels.
Fresno	Coalinga	15.406,619
Kern	Kern River, Sunset, Midway and McKittrick	24,549,758
Los Angeles	City, Sherman and Whittier	5,409,392
Orange	Fullerton	4.270,967
San Luis Obispo	Edna	30,000
Santa Barbara	Santa Maria and Summerland	8,116,788
Santa Clara	Moody Gulch and Sargents	63,780
Ventura	Ventura	344.419
		58,191,324

Figures by California State Mining Bureau.

[1]Paper read at eighteenth annual convention Pacific Coast Gas Association, September, 1910.

TABLE 2.

PRODUCTION OF PETROLEUM, BY FIELDS.

FOR THE YEAR 1909.

Field.	County.	Heavy Oil, barrels	Light Oil, barrels.
Coalinga	..Fresno	11,554,964 14 to 20°	3,851,655 20 to 30° Be
Kern River	.Kern	14,508,242 13 to 17°	
Sunset	"	1,999,701 11 to 20°	
Midway[1] ...	"	1.787,564 13 to 20°	446,891 20 to 28°
McKittrick.	"	5,807,360 14 to 19°	
L. Ang'les.	.L. Ang'les	529,765 14 to 16°	
Sherman ...	"	3,439,020 15 to 20°	382,113
Whittier ...	"	211,946 14 to 20°	635,839 20 to 30°
Newhall ...	"	57,403 14 to 20°	114,806 20 to 36°
Puente	"		38,500 20 to 33°
Fullerton	..Orange	2,462,581 17 to 20°	1,708,386 20 to 35°
Edna	San Luis	30,000 11 to 12°	
S. Maria[2]...	S.Barbara	3,232,180 14 to 20°	4,848,270 20 to 27°
Summerland	"	66,338 14 to 16°	
M'dy Gulch.	S. Clara		1,800 38 to 42°
Sargents ...	"	61,980 15 to 19°	
Ventura	...Ventura	86,105 13 to 20°	258,314 20 to 40°
Totals[3]		45,815,149.	12,286,547

Production figures by California State Mining Bureau. The gravity estimates are my own.

[1] As you will note from Table 3, the production of the Midway field has greatly increased since the end of 1909. This will make a great change in the above figures for this year, as a considerable part of the new production is very close to 20 degrees, running from 9.5 to 23 degrees. There is but one well of the latter grade, and how much of this sort of production is in sight cannot be told. The bulk of the gusher production runs from 20 to 23 degrees, and if the present proportions are maintained, perhaps half the output of this field for the current year will fall within the latter limits.

[2] The figures from Santa Maria last year were largely for oil from the Old Field and Lompoc. This year Cat Canyon is bringing in a good deal of 14 degree oil, and therefore any increase from this field over last year's figures will go in the heavy oil column.

[3] These figures were partly taken from different sources, and the slight discrepancy from Table 1 has not been corrected. It should be understood that the divisions given are only estimates, while the figures for output are based on direct returns.

TABLE 3.

PRODUCTION OF PETROLEUM, BY FIELDS.

FOR MONTH JULY, 1910.

Coalinga	1,688,959
Kern River	1,118,278
Maricopa (Sunset) (includes Lakeview)	1,095,000
Midway	924,000
McKittrick	474,779
Los Angeles City	38,080
Sherman	285,738
Whittier	89,925
Newhall	12,145
Puente & Fullerton	417,894
Arroyo Grande (Edna)	1,000
Santa Maria, Lompoc and Cat Canyon	713,200
Summerland	5,305
Sargents (Watsonville)	1,500
Ventura	36,162
Total for month	6,901,965

The totals for three months were:

May	7,172,313
June	6,696,789
July	6,901,965
Total three months	20,761,067

Figures by California Oil World.

Considering the great extent of the territory over which search for oil has been prosecuted, and on which there are more or less indications of future production, it may be well to resume very briefly the records of these operations.

Humboldt County.

The most northern developments in California are in Humboldt county, where the search for oil commenced in the early sixties, and still continues at intervals. In the valleys of Bear river and Mattole river, many seepages of gas and light petroleum are found, and a number of the wells drilled in these valleys have found oil in small, but never in profitable quantity. This is a very light oil, and would be valuable for refining and other purposes, but in spite of the wide area over which seepages occur, it is doubtful whether any large production is in sight here. The formation is of shale and hard sandstone, the oil occurring in the latter, and both the hardness of the oil rock and the highly broken and faulted condition of the formation point toward small production per well. While there are some prospects for production, I do not believe that anything may be expected from this territory which will effect the market in the near future.

Shasta County.

To the east, in Shasta county, several wells have been drilled, but so far without finding either oil or any definite encouragement.

Mendocino County.

Coming further south, several wells were drilled in the neighborhood of Ukiah, but without any discoverable result. West of this point, on the ocean near Point Arena, a large deposit of bituminous rock is found, and a number of wells have been sunk, finding only traces of a heavy, tar-like oil similar to the heaviest oils of the valley.

Colusa County.

East of Ukiah, on the boundary line between Colusa and Sonoma counties are several seepages of a most peculiar and remarkable oil (a dark green oil of 15 degrees gravity but quite free from asphalt) but to the present no quantity of this oil has been discovered in the holes drilled. As these seepages lie far back in the hills, in rocks of considerable age and much disturbed, it is probable that they do not indicate the location of any considerable deposits, and that if such exist they will be found in later formations, lying to the eastward.

Sonoma and Solano Counties.

Going south again, prospecting has been done near Petaluma, and in the neighborhood of Fairfield. Gas has been found in some quantity at both points, and oil has been reported from the former. There is considerable territory here which has been but little investigated, and while I believe that several portions have fair prospects of ultimately being brought to production, this requires so much time that there is nothing here to hold our immediate attention.

Marin County.

On the ocean at Bolinas Bay, two wells were drilled some years ago, getting a small amount of a medium grade black oil (gravity 21.5 degrees). No work has been done at this point for some time, and little is known of the history of this venture.

Contra Costa County.

On the eastern shore of San Francisco Bay and the west slope of Mt. Diablo, prospecting has been carried on for several years, and two grades of oil have been found, a brownish oil of about 19 degrees gravity, and a greenish oil of some 30 degrees gravity. The formation here is much broken, and while oil has been found over a wide range, no quantity has been found at any one point. In my opinion the prospects, if any, are farther to the eastward.

San Joaquin County.

In the general neighborhood of the above, and not far from Tracy, a single deep well is now drilling, on

FIGURE 1
SKETCH MAP OF
CALIFORNIA
SHOWING LOCATIONS OF
PRODUCING PROSPECTED OIL-FIELDS
DATA FURNISHED BY
CALIFORNIA STATE MINING BUREAU
LEWIS E. AUBURY
STATE MINERALOGIST

the foothills of the Coast Range, and in the same position relative to the hills as the East Side wells at Coalinga. This well is said to have found considerable oil, and has just been cemented. Definite results are not yet known. If the report should prove to be true, this territory would be one to reckon with in figuring future production, as the rocks are here regular for long distances, and a strike at any one point puts in the possible class quite a strip of territory.

Alameda County.

On the Bay side of the same range, in the Livermore Valley, a number of wells have been drilled, most of them dry, but two or three showing a small quantity of oil, ranging from a thin brownish to a thin, dull green oil. It is probable that these all belong in the refining class, commercially considered. Several wells drilled in Corral Hollow gave no indications of oil. It is yet too soon to say what the prospects for the Livermore country may be, but it is perfectly safe to say that it will not in the near future produce anything to alter market conditions.

San Mateo County.

On the ocean face of San Francisco peninsula, oil has been found in Purissima creek and in Tunitas canyon, San Mateo county. Seepages here cover a considerable area, and a number of wells have pro-

duced some oil, from a fraction of a barrel up to two or three barrels per day. No profitable production was had, and it seems doubtful, considering the amount of work which has been done, whether there are any prospects for the future. These oils range from 21 degrees to 50 degrees in gravity, and are mostly quite light, brownish green oils.

Santa Clara County.

In the Santa Clara Valley, near the town of Los Gatos, a little 15 degree gravity oil was found in wells drilled some years ago. Active prospecting is now under way, but is not yet far enough advanced to warrant any opinion as to the results.

A few miles farther south, the old producing pool in Moody Gulch seems to be about pumped out, and while a small amount of oil is still being raised, new work done in an effort to extend the field or find a deeper sand has been unsuccessful. This is a thin green-brown oil of about 40 degrees gravity.

At the point where the boundaries of Santa Cruz, Santa Clara and San Benito counties join, a small district has been developed back of Sargents Station, on the Santa Clara side. One company has several wells producing a black oil ranging from 16 to 19 degrees, but neither this company nor others who have drilled here have succeeded in extending production over more than a few acres.

In the neighborhood of Santa Cruz considerable work was done some years since, but without any results whatever, and this district seems to be thoroughly condemned.

San Benito County.

Three wells have been drilled near the town of Hollister, without any result.

In Panoche and Vallecitos Valleys, an elevated table-land lying on the eastern margin of San Benito county, and separated by a single mountain range from the San Joaquin Valley, oil has been obtained in moderate quantity in a number of wells, while others have been dry. Strong hopes were once entertained of bringing much of this territory into production, but to the present no commercial oil has been found. While this territory is more or less broken, and there are small chances of developing any extended fields, I am of the opinion that there is, on the whole, a good deal of oil here which will be drawn on in future. Much of the land in this vicinity is held by one company, which is not now increasing its production. The oils found here vary considerably, but in general resemble the lighter oils of the valley, ranging from 20 to 26 degrees in gravity.

At the southern end of San Benito county, at the junction with Monterey, oil has long been known to exist in the Bitterwater valley. On one side of the fault which extends through this country a light green oil of 42 degrees gravity is found, but not in commercial quantity. On the other side a couple of wells have found traces of a heavy black oil, but though a number of wells, some of them quite deep, have been put down here and in the adjacent Topo country, no production has been had, and the prospects do not appear to be brilliant.

Monterey and San Luis Counties.

Where these counties join, a large deposit of bituminous seepage material is found in the San Antonio valley, west of Bradley. Here, and to the north and south, many wells have been drilled, but with no other result than to find a little heavy tar near the surface. Some work is now under way, and in spite of repeated failures I am of the opinion that oil measures do exist in this neighborhood, though not, perhaps, just where search has been made. There are no prospects here of immediate interest.

San Luis Obispo County.

In the northeast corner of this county, and just across the divide from Coalinga and Kreyenhagen, considerable work has been done in Cholame and Parkfield valleys, but without finding any profitable quantities. What the prospects may be here, I do not know.

In the southern part of the county, south of the town of San Luis, are extensive tar seepages, and prospecting has been done along a strip extending from Port Harford to Arroyo Grande, and up the Huasna. At Edna a little pool of very heavy oil (about 11 degrees gravity) has been opened, but efforts to extend this pool have not met with success, and all the other wells along this strip have been entire failures. There do not, at present, appear to be any very brilliant prospects for any of this territory.

East of this district, some prospecting has been done on the Carissa Plain, on the southeastern margin of the county. Oil has been reported from two or three of these wells, but I have not been able to verify the reports. Not being personally familiar with this territory I have no ground for an opinion, other than that prospecting seems to be abandoned at this time.

Santa Barbara County.

Passing the Santa Maria field, which is a heavy producer and will be spoken of more in detail, the next area prospected for oil is the south coast of this county. Starting at Gaviota, a number of wells have been drilled close to the coast, and some in the hills adjacent, all the way to the mouth of Rincon creek, the boundary line of Ventura county. Production was had at Summerland, but these little wells have just about gone out, and all the other test holes, including three or four quite deep ones, were dry. This is rather remarkable, as the coast abounds in oil seeps, but whatever the reason, this region seems to be thoroughly condemned by the drill.

Southern California.

Passing again the Ventura-Newhall field, and the Los Angeles-Fullerton group, we find that a good deal of work has been done adjacent to the latter, and covering in a scattering way the most of Southern California west of the San Jacinto Range. Wells have been drilled in the Simi valley (these gave some oil at one time, but do not now produce), on the south slope of the Santa Monica Range (dry), in the Repetto Hills east of Los Angeles (dry), on the northeastern extension of the Fullerton field in San Bernardino county

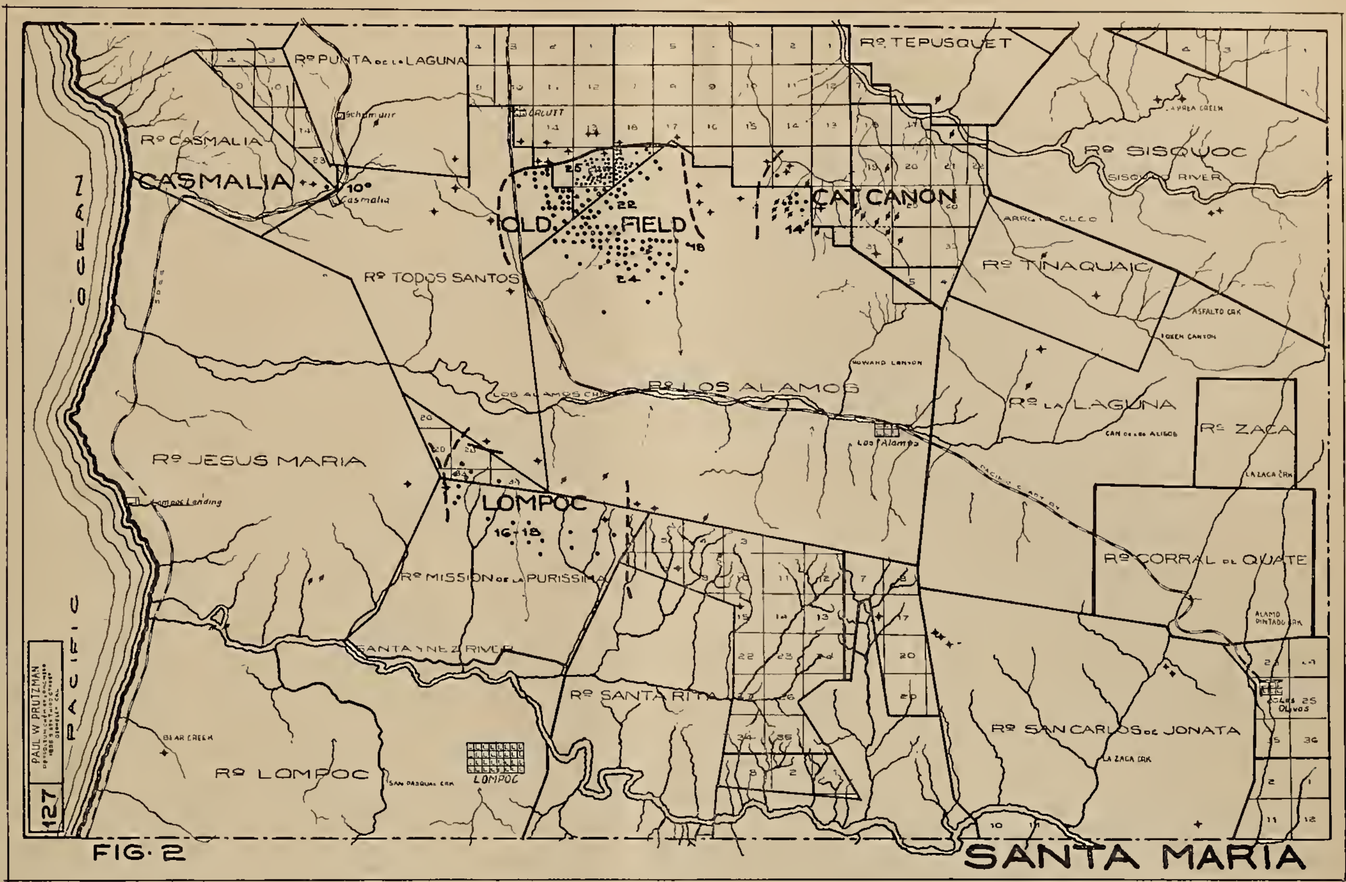


FIG. 2

(very small production), at Newport (small amounts of very heavy oil) and at San Pedro (traces only). None of this work offers much encouragement, but a little new work is now under way at several points.

In San Diego county, along the coast from Del Mar to the Mexican line, a number of prospect holes were drilled several years ago, but only one to any depth. This one showed traces of oil, and some work is now going on, but the country is still to be demonstrated.

San Joaquin Valley.

In the valley we find the producing fields, with the exception of Kern river, all on the eastern face of the Mount Diablo Range, and all located where the foothills meet the plain. These fields were, without exception, originally located by means of seepages. North of Coalinga we find but very few seepages, and these only a short distance north. The long stretch between Coalinga and the well near Tracy is practically untested by the drill, and while these foothills will, in all probability, furnish some of the future oil fields, any developments here are in the future, and need not be taken into present consideration.

Between Coalinga and McKittrick is a stretch of nearly forty miles, almost all parts of which show some indications of the presence of oil. Many wells have been drilled along this strip, and a few of them have obtained oil in small quantity. North of McKittrick, in the Temblor, a very small producing spot has been developed, but this cuts small figure in a production forecast. While it is difficult to speak in general terms of so long and diversified a piece of ground, all indications both of the drill and of geology point to a very serious doubt whether any large production will ever be had in this part of the hills. The oils of this strip range from 16 to 30 degrees in gravity, and from black to a light green in color.

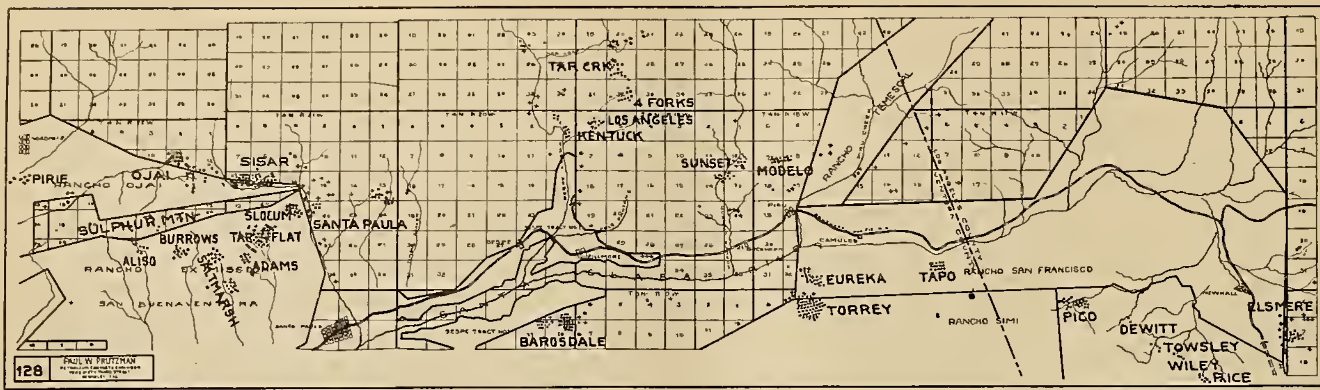
TABLE 4.

SUMMARY OF RESULTS FROM PROSPECTING.

Field.	Oil Found.	Prospects.
Humboldt	Considerable—V. l'gt gr, 48'	For small output.
Shasta	None	None demonstrated.
Mendocino Co.	Traces—V. heavy	None demonstrated.
Colusa Co	Considerable—H'y gr'n, 15'	Uncertain.
Sonoma Co	Doubtful	Not demonstrated.
Solano Co	None	Not demonstrated.
Marin Co	A little—Medium br'n, 21'	Unknown.
Contra Costa	Small amounts—Light	Poor.
San Joaquin	Not yet known	Not yet known.
Alameda	Small amounts	Uncertain.
San Mateo	Considerable—Light	Dubious.
Los Gatos	A little—Heavy black, 15'	Not yet proven.
Moody Gulch	Much—V. light green, 40'	Worked out apparently.
Sargents	Producing—Heavy black	No extension in sight.
Santa Cruz	None	None.
Hollister	None	None.
Vallecitos	Considerable—Med'm bl'k	Various, some good.
Bitterwater	Seepages—V. light gr'n, 42'	Very poor.
Topo	Traces—Heavy black	Very poor.
Bradley	Traces—V. heavy bl'k, 10'	Not yet proven.
Parkfield	Traces	Unknown.
Huasna	Traces—Heavy black	Dubious.
Carissa	Doubtful	No work at present, unknown.

General Conclusions.

It may be seen from the above that whatever prospects we have for increased production, in the near future at least, lie in extension and development of the already producing fields. Several extensive areas of prospected territory may be classed as possible but untested. Two or three are hopeful, but have been so little developed that large production is far in the future. The balance have been condemned, or are so limited by their physical and geological characteristics that they never could produce heavily. (Table 4 sum-



VENTURA FIG-3 NEWHALL

marizes the above). Now let us see what may be expected from the fields already developed.

Field Maps.

In examining the various maps attached, a series of heavy lines, solid and dotted, will be noted, surrounding certain groups of wells. Where solid, such a line is meant to indicate a limit to extension in this direction, shown with some certainty by the results of drilling. When dotted, it represents a probable limit, not definitely known, and based on the writer's opinion. Where the lines do not close, no data exists setting a limit on the open side.

It should not be understood that no oil may be found outside such limits, but only that no extension of present groups is likely in such directions. New producing areas may be found outside, but not connected with present developments.

Abandoned wells are indicated by a dot with four arms, forming a star. Drilling wells by a dot with sloping cross bar. Producing wells by a plain dot. Most of the producing wells are shown, in approximately correct position, a fair proportion of the drilling wells outside of proven limits, but abandoned wells are shown only where, in the writer's opinion, they have a bearing on establishing limits.

Santa Maria (See Map No. 2).

The Santa Maria field really comprises four subdistricts, three developed or partly developed, the fourth indicated only by a single well.

Near Casmalia Station, on the Southern Pacific, the Kern Trading & Oil Company have a well which appears to be capable of producing considerable very heavy oil (about 10½ degrees). To the north and west are several abandoned holes, two or more quite deep, and considering the extreme weight of the oil, it is hardly likely that this territory will have much effect on future market.

The Old Field or West Side was the original scene of activity in this region, and has been thoroughly marked out and largely developed. The oil from this group of wells runs from 18 to 28 degrees and averages about 24 degrees gravity.

At the north this field is limited by several failures, one of them a full 4000 feet deep, and dry. To the west there is but a slight possibility of extension—wells here are very deep, approximating 4000 feet, and while several of these had some oil, none were ever free enough from water to give a test of the territory. It appears a little doubtful whether, in the present state of the art, productive wells can be drilled here.

To the south drilling is still going on, and no limit can be set—it is even possible that the field is continuous with the Lompoc group, though personally I incline to doubt this.

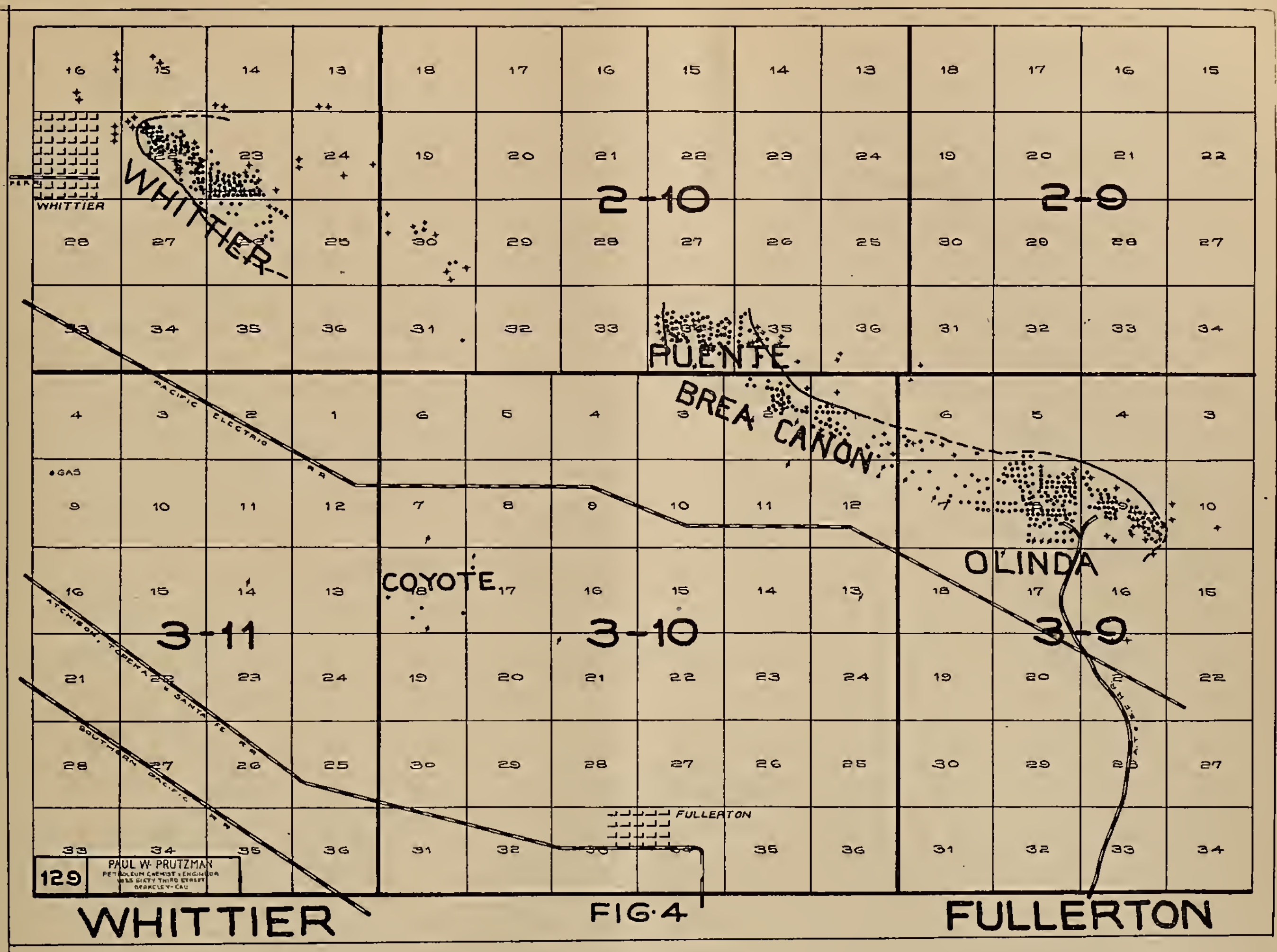
The Old Field some years ago suffered a great setback due to the intrusion of water into the sands on the south side. This trouble has to a large extent been remedied and the production recovered. On the northern side of this group the wells are free from water, and production has been remarkably steady and continuous. I would estimate that the production from this group would remain at about the present figure for some time to come.

The Lompoc or Purissima group of wells is anomalous in that the larger part of the wells and of the territory surrounding them are the property of a single company. For this reason accurate information is hard to obtain. We know that, to the west and the north, bounds have been set by two very deep holes, both entirely dry. To the northeast a producer has lately been brought in, and no definite bound has been set in this direction, nor to the south, though I believe that the furthest wells south do not greatly encourage drilling in this direction. To the east extensions are blocked by several deep holes, showing some oil but not a workable quantity—one of these holes is more than 4600 feet deep, and therefore the next to the deepest in the State.

Even figuring that there is little prospect for any material extension in area here, the country already blocked out and proven by scattering wells is so large that there are undoubted capabilities for a considerable production, whenever the owners of the property think best to develop it. As it is in the hands of a corporation who are vitally interested in maintaining prices, I do not believe that we have any reason to expect this oil to be brought onto the market until the latter is ready to absorb it, which puts it into the indefinite future.

The oil from these wells runs from 16 to 18 degrees in gravity.

In Cat Canyon we have a peculiar state of affairs, and one hard to reckon with. Drilling is quite difficult, and many wells have been a long time under way. When finished they show considerable differences in behavior. Two of these wells are very heavy pro-



FIG·4

ducers, and as the sands appear to be rather uniform, it would seem that contiguous wells should also produce heavily, but most of them do not. Whether this is due to tar choking back the oil, or to other causes, I do not know, but the fact makes the field difficult to figure on. So far the field has not been limited by failures, except to the west, and there is even a possibility that the gap here, between the east and west fields, may be bridged. In any case, work now done shows up a considerable area capable of producing and which should be making a great deal of oil, though as a matter of fact a large part of its output comes from the two flowing wells mentioned. What the actual future of this field may be I cannot say, but I feel sure that it will bear watching by anyone interested in the oil market.

The oil from this group of wells is of one quality, and that quite heavy, about 14 degrees gravity.

Farther to the south, some drilling has been done in Foxen Canyon, and in the valley of the Santa Ynez river. None of this work has given encouraging results so far. This will presumably be heavy oil if any production is had.

Ventura and Newhall (See Map No. 3).

The strip of oil producing territory running the length of the Santa Clara river, in Ventura and Los Angeles counties, consists of a number of small separated pools, about twenty-seven in number. All of these patches of producing territory have been known and worked for a long time, and most of them have been more or less defined. Some new development work is under way on Sulphur Mountain and in the Ojaa, Simi and Tapo, and some success has been met in attempts to extend the Santa Paula, Tar Creek, Four Forks and Sunset groups. The production of each of these groups is so small, and the available territory so limited, that it would be tedious to consider each group separately.

Taken as a whole, this district does not give any indications of a large increase in output in the near future. During the last two years, with a high price for oil, the present wells have probably been worked to about their capacity. Without question there is considerable territory here which will be developed in future, but as said, it lies in small patches, and prospecting is slow and uncertain. I would estimate that this district would hold its own for a long time, the production of most of the wells, while small, being very steady, but will probably not show much if any increase.

Perhaps three-quarters of the oil from this district falls in the light or refining class, and it seems likely that this proportion will continue. Gravities range from 12 to nearly 40 degrees, and are mostly between 24 and 30 degrees.

Whittier and Fullerton (See Map No. 4).

The Whittier district proper appears to consist of one producing sand, and as this dips sharply, the

producing territory is of no great area. Wells are quite productive, however, and a small amount of new work is sufficient to maintain the production level.

This district appears to be limited at its west and northwest edges. There are some prospects for extension to the north, and perhaps, in spite of repeated failures, to the east. Nor can any definite line be set to the south, though it must be said that, unless the formation changes its angle in this direction, extension cannot proceed very far. It is altogether probable that the production of the Whittier field proper will not be greatly increased, though it is not likely to fall away for some time to come.

In Coyote Hills and in La Habra Valley, south and southeast of the main field, two productive spots not apparently connected with the main body have been discovered within the last five years. These are both deep drilling, and while no limits have been set, and there is likely to be considerable good ground here, development will be slow. These districts produce light oil.

The Puente group appears to be capable of extension to the north at least, and probably to the south. The production of this group, which is all light oil, does not come onto the market.

Some success appears to have been met in extending the Fullerton and Brea Canyon fields to the south, and no limits can be set in this direction. Both of these groups appear to be limited to the north, and Fullerton to the east, and incapable of extension in these directions. The oil from the eastern end of Fullerton is quite light, about 30 degrees, that from the body of the field is from 17 to a little above 20 degrees and that of Bear Canyon slightly heavier still. The oil from the new wells to the south is notably lighter, averaging well above 20 degrees.

It should be remarked of all this southern territory that, as there is an ample local demand for the entire production, none of this oil crosses the Tehachapis, and therefore does not at present cut any figure in the general market. A considerable increase in the production from the southern fields might operate to displace a certain amount of Valley or Coast oil, but this does not appear to me at all imminent.

Los Angeles and Sherman.

Both of these fields are sure to show a slow but steady decrease in production. Within the city limits of Los Angeles drilling is forbidden by ordinance, and the fields have not been extended beyond these limits except to the southwest. The Sherman field is in much the same condition—the drilling time allowed by the best of the leases has expired, and but little drilling can be done within the proven limits.

A good deal of work has been done to the east of Los Angeles city, and some is now under way. There is of course the possibility that some entirely new territory may be brought in at any time, but at present there is nothing to indicate it. No map of this territory is given, as the wells in the Sherman field belong largely to two companies, and the production of the city is too small to warrant. City oil runs about 14 degrees gravity, and that of the Sherman field ranges from this figure to slightly above 20 degrees.

(To be continued.)

"OLLA PODRIDA."

BY THE CHEERFUL IDIOT.

"Olla Podrida" is figuratively applied to literary productions of very miscellaneous contents."—Encyclopedia

An intimate friend of mine asked me some time ago, whether I was ever serious in my life. He was prompted to ask the question under the following circumstances: I had recently joined a lodge of which he was a prominent member. He wanted to know what I thought of it generally—but more especially the initiation ceremony. Oh said I, its very fine and impressive, but somewhat reminds me of the story of the Ameriacn gentleman and a Scotch friend of his. The Scot being very patriotic and full of love and pride for the land of his birth, used every evening to dress in full Highland regalia, take his bagpipes and march up and down his room playing good old Scotch airs. His American friend who by the way had a very fine looking daughter, invited him to dinner and asked him to bring his pipes. The invitation was gratefully accepted. Dinner being over, everyone adjourned to the drawing room. Sandy was asked to play something for them. He said he would willingly do so, if they would permit him to retire into another room for a short time. His request was granted, and soon after the squealling and groaning of the pipes was heard, and in comes Sandy in full regalia. He was greatly admired by the daughter who seemed unable to take her eyes off his manly form. When he had finished playing and had marched out, the American said to himself, The music may be alright but I don't see why the devil he couldn't play just as well with his pants on as with them off. It was then that my friend threw up his hands in pious horror and said "Good Lord man! were you ever serious in your life?"

Now the easiest way to obtain the bagpipe effect without a Scotchman is to procure a good healthy pig—jam it carefully under a gate so that it cannot go either way, and then stand on it; with a little practice one can produce sthathspeys, reels, pibrochs, or most anything. I am not quite sure about "pibroch." I mean I don't exactly know whether a pibroch is a part of the bagpipe or whether it is a part of the noise a bagpipe makes, but then one can't be expected to know everything. Some years ago a dynamo exploded in Station B, of what was then the Cal. Electric Light Co.'s plant. An enterprising newspaper reporter in describing the accident said "that volts weighing several hundred pounds were thrown across the street right into the gas Co.'s yard." Talking of explosion How little we realize how much we have to be thankful for. I once went through a terrific powder explosion, 3 or 4 were killed and I don't know how many hurt, while I wasn't even stunned. A Dr. who insisted on examining me whether I needed it or not, gave it as his opinion that I had nothing to stun. Many people stand in awe watching a certain steeple jack in this city working at the extreme top of a flagpole several hundred feet from the ground. He is the most wonderful man when aloft I have ever seen as well as the most reckless, at least he appears to be, to the casual observer. This is not really the case. It is an utter impossibility for him to get dizzy, he has

nothing to get dizzy with. Therefore unless something breaks he cannot fall.

And now the elections are over for a while, and we are able to pursue the even tenor of our way in peace. I never was much of a politician, but at the last election I must admit that I got into the political trough with all four feet. So much so that after having shouted my head nearly off for the wrong man, I wound up by going to the polling booth without my glasses and stamping the wrong column on the ballot. This universal suffrage business ought to be done something with.

What really caused me to break out so badly was the desire to do something in my small way to help elect men to the next Legislature who would consider favorably the proposed Engineers License law. I think however that it is most fortunate for myself that the campaign did not last any longer for I verily believe I should have finally gone to jail. I attended a meeting one evening on which occasion the subject of the License Law was brought before the house. Now this had the most astonishing effect of anything I ever saw in my life. Bless my soul! Donnybrook fair is a Sunday school treat in comparison. I was so glad to get away alive. Now why this extraordinary opposition to something which may do some good and which cannot so far as I can see do any possible harm to any one? I can understand people not appearing to care about the matter one way or another and the reason is simple. There has not been a boiler explosion in S. F. since somewhere back in the early eighties. Why? Well for two or three reasons. Good material in construction, and better material handling the machines. I think I am perfectly safe in saying that there is hardly a class among all professional men who study more to improve themselves and keep thoroughly up to date than do the engineers. How few people stop to think that at almost every step as they walk our streets they are directly over a mine, a mine of such tremendous power, that should a careless engineer happen to pull the wrong string, well there's no doubt some effect would be produced, which might start some people thinking. Sometimes it takes quite a shock to wake a person up. Doctors are licensed and are thereby protected from outside interference. I know one who is now perhaps 48 or 49 years of age, he is sweating up like a school boy to get a Cal. license and he has been practizing in a neighboring state for years. Doctors are protected yet they do more damage to human life in a week than an engineer does in a life time. The doctor's license permits him to make mistakes, which the undertaker buries. The whole proceeding usually being unaccompanied by much noise, except where the unfortunate mistake draws enough water to rate a brass band. The number of mistakes—fatal one, which a Dr. can make are limited only as to the size of his practice. Let however an engineer make one false move and his tribute towards the addition to the population in the other world would be limited only by the number of people who were not in the neighborhood when the false move was made. Yet notwithstanding all this, anyone can come into California and be an engineer because he says he is one. I don't think it's a fair deal.

I was discussing this matter with a very dear friend of mine the other day and when I get interested I get completely carried away. Now my friend has a pair of most umbrageous feet. More so in fact than those of the average policeman. I wondered for a long time why he always had a cold, but there is nearly a third of him on the ground which I think must have something to do with it. As I said, we were discussing this License law question very thoroughly, and in my excitement I commenced to walk about, subsequently walking mostly on my friend's feet. This circumstance is the cause of my forgetting exactly what conclusion we both came to. Says he "Get off my feet." Says I, "I must step somewhere," and he got insulted. The engineers as a class, and I think the majority of them throughout the state are in favor of a license. There are some sore heads among them who because they are unable to have things all their own way go about knocking the movement. And accusing the members of the engineers committees who have the matter in hand, of graft, trying to further their own political ends, and so forth. I believe this is wrong, in fact I know it is wrong. I am personally acquainted with every man on the committee. They are, as a collection, as fine a crowd of gentlemen as ever got together, as individuals they each have the qualifications which make good engineers and good citizens. Politics! Yes, of course they must do politics. The measure must be brought before the politicians, it needs their support. Members of the committee must therefor meet the politicians and ask for their support. I ran around, not as a committee man but as a guest of the committee, as I said, doing politics. Never had such a time in my life. Spent lots of money (not my own) rushed from one precinct to another. Got in to trouble for trying to get votes for my man within the 100 ft. limit. Got pitched out of an auto, told all kinds of seasonable and unseasonable stories, apropos of everything and nothing. Got pinched for falling thro somebody's glass door, and then the other man got elected. Yet there are some people who accuse the committee of trying to serve their own selfish, political ends. What d'ye think of that? Has any one ever noticed how difficult it is to make up one's mind what to do when alighting from a street car, or even what to do when in crossing the street, one has to wait to let a car pass. Let the unfortunate pedestrian stand say 2 or 3 ft. from the car, and he will be painted from head to foot with tobacco juice. If however he stands far enough away to avoid this extremely amusing and characteristic American pleasantary, he will no doubt be scooped up by an auto. I mention this just to call attention to two ways of being amused. San Francisco is a city of amusements. I rode on a car the other morning, two other men were also on the car. We were all on the front end. We passed a building in course of erection. One man said to the other, "What is that going to be." "I don't know" was the answer, but it will probably be a rooming house or a nickelodeon." We had another election the other day, the one on Charter Amendments. This election excited me more and came nearer getting me into jail if possible than the one preceding it. I was particularly interested in Amendment No. 18 relating to the age limit at which a man might enter the Fire Dept. in any capacity. The Charter at present provides that all persons enter-

ing the service of the fire dept. shall be not more than 35 years of age and not less than 21 year of age. Now if this rule were lived up to to the letter, and if the example of the city Charter were followed by private firms, the limit of a man's usefulness to his fellowman would be 14 years; after which—what? Our old friend the Psalmist of whom I presume many have heard, took time, in the midst of his lamentations (and he always had some kick coming) to tell us that the duration of a man's life was three score years & ten. We shorten this phrase to suit the rapid condition of modern times and say—70 years. Our present charter prevents a man over 35 years old from entering the fire dept. Why?—because after having passed that age the man is considered physically unable to handle himself—too weak to hold on to a horse, go up a ladder or to sustain the weight of his helmet; but, between the ages of 21 & 35 he is supposed to be fit for anything. If then in view of this, he is permitted to join the fire dept. he should logically be expunged from the map as soon as he passed his 35th birthday. Should this really be the case he would spend 20 years in getting ready to hold a 14 year job. A portion of this time would be spent in getting born, going to school, learning to roll & smoke the succulent & juicy cigarette, dodge his creditors, also autos, and receive instruction in the art of voting early & often. Then when the fatal day comes i. e. the 35th birthday, he finds himself down & out, but with still 35 years left out of the 70 supposed to be originally coming to him in which to become a tramp or a bum or an unmitigated nuisance to himself, and those around him. Of course this is merely an illustration designed to show the inconsistency of a law of this kind. As a matter of fact the fireman really lasts much longer when once in the dept. the length of his career probably being attended to by an open elevator shaft or something. Charter Amendment No. 18 was introduced for the purpose of correcting to some extent this unjust state of affairs and provides that a man may join the fire dept. between the ages of 21 & 55 years, in the capacity of Master or Pilot in the fireboats, engineers on same, engineers in the pumping stations, and clerks & machinists in the corporation yards, and similar positions where great activity in holding on to hose, running up ladders, breaking things up generally & falling down elevator shafts is not necessary. I may also add, that the men who introduced this amendment waive all right & title to a pension, without in any way desiring to take the pension away from those who earn it. This amendment I am sorry to say encountered the most extraordinary opposition, from all sources, Why, I can't for the life of me see. Its passage could not possibly do any harm to any one and would be a great benefit to many. That it did pass with no particular credit to the supposed liberal spirit of San Francisco, for it only carried by 388 votes, showing that nearly one-half of the voters of San Francisco are willing to either be chloraformed when past 35, or else willing & seemingly anxious to bum on the community for 35 years. According to the papers, the Merchants' Ass'n, The Chamber of Commerce, The Down Town Ass'n, and nearly all the Improvement Clubs went on record as opposing it. I got awfully worked up about it. I had a political job coming to me. I couldn't take it, simply because thro an oversight on the part of my Father & Mother, I was born ten years too soon. Then I went on the warpath. Commencing by severing my connection with an Improvement Club which had suspended me 3 months previously for non-payment of dues, and of which fact I was in ignorance and winding up by sending a letter to the editor of one of our leading dailies on account of an editorial in which he said, that No. 18 should be voted down, because it was designed to make these boats, pumping stations, etc., "asylums for old men" and calling attention to the fact that men in the fire dept. should be young, active, robust and physically able to cope with a great conflagration at any time. I am calmer now the amendment has carried, but I will give the letter verbatim:

San Francisco, Nov. 14th, 1910.

Sir:—Enclosed find clipping from today's paper. My time is too limited as is also my vocabulary to give you the roasting you deserve. However, as I am over 35 years of age, I am physically unable to earn enough to pay for the luxury of reading your paper, you will therefore stop its delivery to the above address at once. As I am over 35 years of age, I am physically unable to earn enough to patronize anyone of the broad and liberal minded individuals composing the Merchants Assn. in future therefore I shall be compelled to send east for my necessaries because, even with freight added I can beat S. F. prices at least 50%. As I am over 35 years of age now, I shall be much older in 1915, as I shall no doubt by that time be still further physically a "has been" I shall probably be unable to afford to visit the Exposition: Therefore, as I don't care, under the circumstances whether it gets here or not I shall vote against Amendment No. 1.

It is the duty of an engineer, either on a fire boat or in a pumping plant to furnish water in case of fire, as he is not called upon to do this with a hand pump I fail to see where he has to be physically qualified to vigorously do any fighting.

Respectfully, etc., etc.

This letter was written in the height of extreme anger, and conveyed by sentiments to the letter, but as I generally borrow a paper no one was out much, and as to sending east for anything—that is a doubtful experiment. I once sent for a suit of clothes, and after waiting for several weeks, received a parcel, which upon inspection was found to contain 3 scrubbing brushes, a pair of carpet slippers, 200 clothes pins, 6 cans of kippered herring and a pair of corsets. It occured to me at the time that some mistake had been made somewhere. The experiment was not a success. A friend of mine once eat two castor oil beans as an experiment—he told me afterward that the experiment had been most eminently satisfactory. Really, we must all work together for our common good, boost the city & the state—patronize each other—work for the fair, and get it, or we may go off the map. Let the coming Christmas actually be, in action as well as in name, a season of "Peace on Earth, Good will toward men," and may each birthday as it comes and goes, find us more charitable, more kind and more desirous of helping those who perhaps thru a mistake in selecting their parents are less fortunate than we are.

(Note):—The editor of this "Journal is not responsible for any of the foregoing nonsense. I am prompted to offer it in the hope that I may run the risk of getting the paper sent to me free for the coming year. If it is not accepted, I shall have to borrow it like I do the daily—or buy it which is distasteful.

PEAT BOG FIRES.

The Pacific Telephone & Telegraph Company recently encountered an unusual situation in the course of the repair of a pole line between Holt and Middle River, small stations on the Santa Fe Railroad between Stockton and San Francisco, as described by J. F. Lowrie in the company's magazine. Investigation showed that standing poles were completely burned off at the butt at a level with the ground, there being absolutely no support but the aerial wires. For a distance of about 8 miles the lead passes through a section of peat bog or marsh, which for the greater part of the year is covered with water. However, there is a period of about four months in the summer during which the water disappears and the bog dries out to a great extent. At times the peat is ignited by camp fires or lighted cigarettes and cigars thrown from the car windows of passing railroad trains, and while no flame is apparent, the fire burns rapidly under the ground and its first indication is from thin columns of smoke which arise through crevices or holes in the ground at a distance of from 20 to 50 ft. apart.

The lead was originally built through this country about ten years ago and consisted of 30 ft. square cedar poles. From time to time local patrolmen have had occasion to re-set and later on to stub poles, the trouble being attributed to grass fires, and as these have not been an uncommon source of annoyance, this particular trouble was not given special consideration until recently.

It has been necessary to replace 200 poles within a distance of about 11 miles, and in order to provide for their protection in the future the scheme of encasing 7 ft. of the butt end of the pole in a jacket of reinforced concrete has been adopted. The method of placing the casing is as follows: First, "junk" strand is placed longitudinally from the base of the pole to a height of 7 ft., and spaced about 2 in. apart. One-inch iron wire mesh is then wrapped around the pole over the strand and securely fastened, care being taken to cover the bottom end of the pole. Then concrete made of 3 parts sand to 1 part Portland cement is plastered to a thickness of ¾ in. over the pole, and it is allowed to thoroughly set before the pole is placed in the ground. The approximate cost of placing the concrete casing is $1.60 per pole. As this protection has not as yet been thoroughly tried out it cannot positively be said that it will serve the purpose intended, although satisfactory results are confidently anticipated.

The Santa Fe Railroad Company has been bothered constantly by these fires, although no serious trouble has resulted therefrom, due to a close watch for the fires and extinguishing them before the undermining of the roadbed. The company has been fighting peat bog fires for the past ten years for about six months every summer at an expense of approximately $75.00 per day. Many methods were employed but none were entirely satisfactory until that now used was adopted. Merely flooding the surface is not sufficient to extinguish the fire, because the water in percolating through the hot fibrous peat is heated to the boiling point and escapes as steam. The method used at present to fight the fires is to force water under high pressure into the burning mass. For this purpose a fire train has been equipped with hydraulic pumps which pump the water out of large drainage canals on either side of the right of way. The pumps are installed in box cars and receive the water through 8 in. reinforced suction hose and discharge it through 3 in. fire hose. The equipment consists of 2 pumps, about 150 ft. of suction hose, and 1500 ft. of discharge hose. The fire crew is composed of one engineer, one fireman, two pump tenders, one conductor, one brakeman, one foreman, and nine laborers.

Generally speaking, we have found that the peat encountered is a kind of soil formed by the partial decay of aquatic and marsh plants which is covered each year by detritus deposited by the flood waters. During the summer months the peat dries down to a depth of three or four feet, depending upon the level of the surface water. The fibrous strata of peat in the lighter and more spongy varieties, when dry, are exceedingly inflammable. As far as we have been able to learn, peat bogs are practically unknown on this coast, and in fact appear in only a few localities in the United States.

IRON AND STEEL BY ELECTRIC PROCESS.

Experiments to produce iron and steel from Norwegian ores by the electric process have been made during the last three or four years, partly by aid from the Government, in response to a petition sent to the Department of Commerce and Industries by the Christiania Polytechnical Society. Private interest has in this manner been awakened, and the industry now promises to become one of considerable importance. The Norwegian iron ore is often so poor that smelting by the old process was found profitless.

The owners of a paper mill at Tinfos, in Notodden, Telemarken, Norway, have for some time been making experiments for the purpose of producing iron by smelting iron ore by the use of electricity as the source of heat. The works were completed in February last, and there has already been an output of 250 tons of iron. The ore used has been mined partly at Lango, near Kragero, and partly at Klodeberg, near Arendal. The melting was accomplished by the use of an electric furnace of about 500 h.p. This is the first iron produced by the new process, and in commemoration of the event there has been cast and sent to the Christiania University an ingot of the metal weighing 60 kilos and provided with an appropriate inscription.

A stock company, styled the Hardanger Electric Iron and Steel Works, is at present being organized. The capital stock is to be $294,800, of which there has already been sold $160,800. There are 4400 shares of $67 each. The works are to be located at Ullensvang, in Hardanger, on the west coast, and the object is to produce iron and steel from Norwegian ores by a patented electric process of Swedish origin. The company has secured electric energy from the adjoining water-power at Tysse, for a period of thirty years, at a cost of $8.04 per h.p.; 4200 h.p. will be required. The ore to be used is to be brought from mines in other districts on the best obtainable terms. The transportation of the ore will be found expensive, but it is believed that this drawback will be offset by the cheap power and excellent harbor facilities at the place.

GAS PROSPECTS IN HARNEY VALLEY, ORE.[1]

BY CHESTER W. WASHBURNE.

The gas prospects in Harney Valley, Central Oregon, are located at places near Malheur and Harney Lakes, 90 to 105 miles directly southwest of Vale. The region is underlain by tertiary lake beds, which are probably equivalent to the Payette and Idaho formations of the Snake River Valley.

The valley was visited by the writer in 1899, before prospecting began, and the following information about the wells has been kindly furnished by Mr. R. B. Post of the water-resources branch of the Geological Survey, stationed at Burns, Ore.; by the officers of the Harney Valley Oil and Gas Company, and by others.

In February, 1909, a strong flow of gas was struck at a depth of 357 feet, in a well drilled for water by John Leake about 15 miles south of Burns, Ore., in the SW. ¼ sec. 28, T. 25 S., R. 32 E. The gas is said to have forced the tools out of the well and to have "hurled sand and salt water into the air to a height of 40 feet." In October, 1909, the flow of gas still continued, but with diminished pressure and small volume.

From a sample of the sand thrown out of this well, a "very small quantity of oil" was obtained by C. E. Bradley, chemist of the United States Experiment Station, Oregon Agricultural College, Corvallis, Ore.

The well is only 2 inches in diameter at the bottom and was drilled with a "light hydraulic rig."

Along the north shore of Harney Lake, 12 to 15 miles southwest of the Leake well, mentioned above, 11 prospect wells, 74 to 252 feet deep, have been drilled by the Harney Valley Oil and Gas Company, of Burns, Ore. The wells are half a mile apart in secs. 20, 21, 27, 28, 29 and 30, T. 26 S., R. 30 E.

Traces of gas are reported from all the wells, the heaviest flows being derived from depths of 74, 150 and 252 feet, from different wells. The quantity of gas obtained was not of commercial significance, but the wells are too shallow to test the field, and until deeper wells are drilled no conclusion can be formed as to the amount of gas available.

All the wells, including the Leake well, were "drilled with a light hydraulic rig, with which it was not possible, on account of the heavy gas pressure, to penetrate below the sand in which the gas was struck."

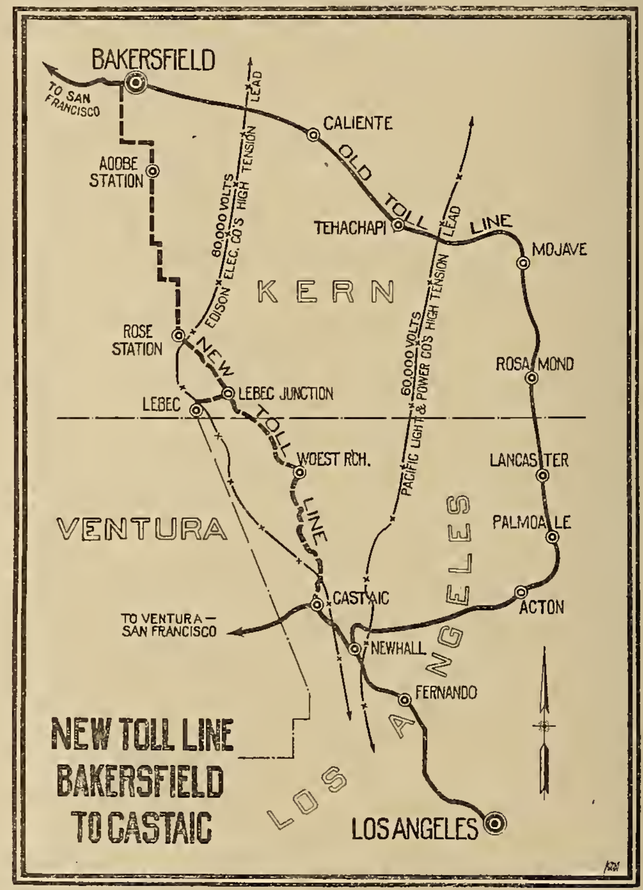
The strata penetrated by the wells in Harney Valley are of the same general character as those in the Snake River Valley, with which they are probably continuous except as they may be interrupted by two or three ridges of volcanic rocks. The nearest marine deposit known to the writer is the Jurassic red sandstone at Red Butte, in the foothills of the Blue Mountains, about 20 miles north of Burns.

The rocks of Harney Valley have a general synclinal structure, the dip steepening toward the central part of the basin to angles ranging from 3° to 10°. Indications of minor folds and faults have been seen, but geological work in that region is still too imperfect to permit the exact location of these features of the structure. Since this report was written a paper by Gerald A. Waring on the geology and water resources of the Harney Basin region, Oregon, has been published by the Geological Survey as Water-Supply Paper 231, from which it appears that the sediments in Harney Basin overlie the lavas and probably do not exceed a few hundred feet in thickness. They therefore cannot be equivalent to the Payette formation, as suggested above. This new information makes it improbable that more than a small amount of shallow gas can be obtained in the basin.

[1]Extract from Bulletin 431A, U. S. Geological Survey.

DIFFICULT TELEPHONE CONSTRUCTION.

An interesting piece of heavy toll line construction recently completed by the plant department of the Pacific Telephone & Telegraph Company between Bakersfield and Castaic Junction, forming a part of the San Francisco-Los Angeles valley route, is described in the company's magazine. There were numerous factors to be considered in this connection, such as the existence of high tension parallels, elimination of submarine cables, coast fogs and reduction of wire mileage to the minimum,



The diagram illustrates the old route of the Los Angeles-Bakersfield line and also shows that taken by the new line, which permitted the shortening of the lines between these points by 39.6 miles. As two power companies, each carrying a pressure of 60,000 volts had already selected their routes, taking full advantage of the highways, and as it was necessary that a sufficient distance be kept from their lines, it was found impossible to follow any existing roads through the Tehachapi Mountains. After a comparison of costs, it was shown that a saving of approximately $20,000 could be made by constructing roads, compared with the cost of following the old route. In addition, the new route would give better efficiency.

DISCUSSION OF PAPERS AT EIGHTEENTH ANNUAL CONVENTION PACIFIC COAST GAS ASSOCIATION.

Relations With the Public.

Mr. Basford: Mr. President, there is one thing brought to mind in this paper, and that is, the gas appliance men's part of it. I do not know whether the gas men at large realize that the gas appliance men can unwittingly be of any great damage to both the consumer and the gas company. Many times it is due to lack of knowledge and other times it is the easiest way to get out of the trouble by laying it on the gas company. The companies could give data to appliance men with regard to the proper answers to ordinary complaints from the consumer, so that no matter how anxious the appliance man is to keep harmony, that he will not make a statement that is derogatory or detrimental to the gas company, but he will answer properly or at least turn the complaint over to the proper department for adjustment. On the other side the employes of the gas company who have willfully spoken against any gas appliance which, in the opinion of the company, is worthy of use by the consumer, should be severely dealt with. They should be given instructions to report the complaints to the company selling the appliance if it cannot be properly adjusted. Gas appliance men know it is easy for the gas company employe, if you have such and such a device, to say, "That is all wrong; that is no good." I know that is done too often. On the other hand it is just as important that the gas appliance men should not throw the blame on the company, and therefore, I believe that some way should be devised by the companies at large to settle little troubles and differences that may arise, and keep things working in harmony.

Mr. Berkley: I want to say that I think Mr. Kennedy has struck the key-note of establishing relations between the public utility corporations and the public better than anything I ever heard. I know of no man better able to speak on that subject than Mr. Kennedy. I want to say that I so heartily endorse what he has said that I think if this document had been promulgated ten years ago there would have been a different feeling between the public and the corporations.

I want to say one more thing. Mr. Britton said, "Like masters, like man." The Edison Company has a written notice, and has had it in its public offices for years, hanging in a little frame, that outlines distinctly the relations of the company with the general public. I have never gotten away from that since the time I was employed there, and I believe that if we men would take this same doctrine into our business, and our workaday lives, a good deal of friction would be removed. Take the little thing of the telephone, for instance. The telephone is undoubtedly the greatest means of modern business communication. It is more distinct than a letter. A cross answer over the telephone causes the consumer to immediately damn the whole company. I believe, gentlemen, we will under-estimate this paper unless we thoroughly consider its teaching, and I move a vote of thanks be tendered to Mr. Kennedy for this most valuable paper. (Carried).

Mr. Britton: I don't feel that we should pass Mr. Kennedy's paper with a mere perfunctory motion. I agree it is the best exposition on that subject I have ever listened to. What you are aiming to do, and what Mr. Kennedy is aiming to do is to bring home to the man in the homely truths he has stated. I think that if the companies represented here would, as soon as Mr. Kennedy's paper is published, call together the men who are responsible for the conduct of the company toward the public, and read that paper to them and furnish copies to take home and read, and see that meetings are held with the subordinates at least once a month, so that they will be taught from the mouths of the men that direct them the spirit of the company that then, and then alone, will the paper do some good; but let it rest here in our own body and congratulate ourselves on having a man big enough to place truths before us in regard to our attitude to the public—that will accomplish nothing. I think the companies represented here should get into close daily contact with the men so that the men would know what your policies are.

General Policy Regarding Pipe Extensions.

Mr. L. P. Lowe: I would like to ask Mr. Luckenbach what he considers a bonus.

Mr. Luckenbach: I would consider a bonus the payment of any money for extension of a main.

L. P. Lowe: What do you mean by "payment"—that is a rather broad statement.

Mr. Luckenbach: I believe gas mains are intended to enable consumers to obtain gas from those mains and the revenue should be from consumption. In other words, I should not be permitted to pay the company one penny to lay a main into a vacant tract of land to pay for that extension. The capital invested in the company should be represented by the property of the company.

L. P. Lowe: That does not reach the question yet. What do you consider a bonus? Do you mean the giving of money or payment of money that may, at some future time, be re-paid?

Mr. Luckenbach: I believe an extension should be made without the payment of any money or deposit of any money to be used up or returned at any time.

L. P. Lowe: I can't agree with you. I want to say a little more. This question, if you recollect, came up at the last meeting of the Association. I think Mr. Luckenbach was there. I called your attention to many instances wherein I thought that companies, and especially small companies, could seek assistance from consumers, wherein the payment was not at all in the nature of a bonus. If I understand the meaning of the word "bonus," it means the outright giving of money and not a loan. I know of several instances wherein people have wanted gas in localities in which it was entirely out of the question for the companies to supply it, as the business would not warrant the extension, and in those cases, which have been accepted time and again, that the consumer advance the money and which would be re-paid in gas. A company in which I am interested supplies a district which took three or four miles of pipe, and in which there were but three or four houses when the pipe was laid. The work was done by money advanced, on the re-payment plan, by a real estate concern owning the tract, and if that concern wished that pipe for the purpose of aiding in selling the property, would it be right—would it be just and equitable; would it be common sense for the company to refuse to extend the pipe under those circumstances, and would you think that was a bonus?

Mr. Luckenbach: I would not extend the main except upon the idea of revenue basis to the company. I believe it works injury to the company which is far greater than any benefit which may be derived from the bonus, and I believe the very man who agrees to pay is going to be the eventual enemy of the company and fight it.

L. P. Lowe: I can't see the logic of your argument. In many cities, real estate concerns have furnished money to pipe their tracts, as an added inducement, and the cost of which has been added to the sale price of the lots. It is a legitimate proposition, and while I do believe that the company should, in time, reimburse those who paid, I do not believe the real estate concerns should be denied the privilege of paying for the pipe, and turning it over to the gas company. If you will say it is unfair for the gas company to accept money given to assist in the building of works, I will agree with you, but, I submit it is proper for a company to accept money in the way I have stated.

Mr. Luckenbach: Mr. Lowe, you speak of payments to be returned. My proposition is that wherever a consumer, or would-be consumer, is permitted to contribute in any way to the extension of the system he is at heart an enemy of the system, and of the company which permits him to do it, and it finally works more harm to the company than good. I could show you cases of the kind to which you refer where the very men that

paid for the extension stated that they would fight the company, and go to other companies if they could get service from them. I believe that the time comes when a man feels hard to the company that has made him pay for what his neighbor gets for nothing.

L. P. Lowe: Do you speak of unoccupied territory, or territory in which the company should justly extend its pipes, where business is procurable? Of course we all know it is the general policy of a company to extend 100 feet to reach an average consumer, but there have been many places in California where tracts have been piped by the owners of the land as mere real estate speculations, and without which they could not sell the land. On the repayment plan, if the business comes they get their money back, and if it does not the company has not wasted its capital. I don't call that a bonus.

Thaddeus Lowe: Mr. Luckenbach made a statement a few moments ago that he didn't believe in making any extension unless it was going to bring some revenue to the company. I think he is quite right. Neither do I believe that a tract where there are a great number of consumers, or a few consumers, should be left without gas at the dictates of the company, simply because they didn't consider the consumers sufficient in number to make a profitable return to the company. Now, it is the duty and privilege of the gas company, I think, to direct business to itself or to its territory, and if there is a large vacant tract of land that some real estate man is having piped, you know by serving that tract of land with all modern conveniences you are going to build it up, and you are going to increase business on your system. There is no question about that. We have one case of our own. There was a large tract of land that only two or three years ago was alfalfa fields. Today there are 150 homes on it, and if it were not for the fact that the real estate men put up that money, and which the company agreed to pay back, they never would have got their gas in there, and we never would have the business. Through the comments of those men we find the policy good. The territory has been developed and the gas mains through there have been the principal things that developed it. The surrounding tracts have all the other advantages, but no gas, and consequently no homes. I think some of our best friends are people for whom we have made extensions at their original expense, and ultimately paid them back. They not only got their price for their land, but they added the cost of piping as well, and which they again got back from the company.

Mr. Berkley: I have always taken the position in the matter of extensions that if people come to the office for service, that there should be some way in which the company should give them service. I think that if a man comes to your place of business wanting service, and he is told the mere fact that there is not enough business along the line, and he can't get service under any circumstances, he is more liable to be your enemy than if the position of the company was tactfully explained, that the business would not justify the expenditure, and leave it to him if he wants to get an extension by depositing a certain amount of money, and I am rather inclined to think that man would be better satisfied than if he was turned away, and could not get service at all. I think in collecting money for extensions from a consumer, a difference should be made as to whether the money is deposited as a bonus or simply put up as a deposit to be returned on certain conditions—so much in case of one connection, as Mr. Lowe has pointed out, and so much additional for each connection. If the amount would be a bonus, not returnable, I believe we should be a little careful as to the size of the bonus required. If the money is to be deposited you ought to extend to that consumer the ordinary courtesy of building the one hundred feet, and have him deposit the difference, returnable as other consumers come in. A number of extensions have been made on that basis and in the majority of cases—I cannot say all cases—in the majority of cases people who have deposited money have been well satisfied with the result and I think it is far better from our standpoint as companies, to give everyone coming to the office some way of getting service.

Mr. Schade: I would like to ask a question, and that is, I would like to know how much of the annual dividends the company is willing to pay the people who give bonuses.

Mr. Berkley: The amount of the bonus would be part of the earnings of the company, and that earning should be considered in the matter of the fixing of the rates of the company. In that way it is worked back. It would work an injustice upon the rest of the consumers it seems to me, to require the companies to put extensions into non-paying territory. It would simply be justice to the rest of the consumers from a rate question. What right have you to go into a non-productive territory where you would not earn one or two per cent and fix a rate on that? In other words, how can we ask the downtown consumers to help us pay for the outlying districts?

Thaddeus Lowe: In returning loans for extensions, sight should not be lost of taxation and depreciation, on non-productive piping. Where there is no business we should not pay for those items—the man who is benefited should.

Mr. Farwell: I think we are getting a little bit mixed between the owner and the consumer here. The owner of the tract, in paying something toward the cost of bringing gas mains to the property, is a disinterested party after the property is sold, unless he resides there and if he has accomplished his purpose of disposing of his property he is satisfied. The companies—electric companies and gas companies see fit to make a reasonable charge for these extensions to the owners of the property or companies, such as real estate companies, and thus enable them to market their property readily and it seems to me that they would be more satisfied than if the gas or electric companies denied them that privilege.

Mr. Keyes: I would like to state one instance that occurred some time ago. A real estate firm who were starting an addition, voluntarily made the proposition to pay the full cost of the extension in cash, provided we would make the return, and we accepted the offer in a district where there was not a single house, and not likely to be one, and he advertised that gas and water would be extended there, and inside of three weeks eight fine residences were started, which shows it is a good business proposition.

MAP OF WHITTIER-OLINDA OIL FIELD.

The California State Mining Bureau has issued a map of the Whittier-Olinda oil field, in Los Angeles and Orange Counties. To make the map complete, a large number of original maps and surveys were used. These were furnished by the Santa Fe Railway system, the Puente Oil Company, the Standard Oil Company, the Los Angeles Gas and Electric corporation, the Brea Canyon Oil Company, the Murphy Oil Company and others. Data was furnished by most of the operators in the field and also by others. A bulletin is in preparation that presents much information that has not been published regarding Whittier-Olinda and other Southern California fields. The Whittier-Olinda map was drawn by Paul W. Prutzman. Upon it are indicated the producing wells, the drilling wells, the abandoned wells, the wagon roads, the railroads, the pipe lines, the gravity of oils produced and other particulars that are necessary to convey the fullest and most accurate information regarding the field. This thoroughness characterizes the entire bulletin concerning the oil fields that has been in preparation for some months and that will be, when it is issued, the most comprehensive handbook on California petroleum and California petroleum fields that has been published. The Whittier-Olinda map is on sale at the California State Mining Bureau. The price is 40 cents, with 4 cents postage added.

BOOK REVIEWS.

Edison, His Life and Inventions. By F. L. Dyer and T. C. Martin; two volumes, 999 pages, 5½x8½. Harper & Bros., New York City, and Technical Book Shop, San Francisco. Price, $4.00.

This is pre-eminently the gift book of the year for an electrical engineer. Like all good biography it is intensely interesting history, vitalized by the personality of this master workman, whose useful life has been synchronous with electricity's practical development and for much of which he has been the prime mover. In a recent number of the Outlook, the Spectator, a mere layman, lists the telegraph, the telephone, the phonograph and the flying machine as successive claimants to the distinction of being the "eighth wonder of the world," yet Edison is the man that made realities of all but the last of these wonders and this in face of almost insuperable obstacles. A better selection of biographers would have been difficult, for Mr. Dyer has long served as general counsel for the Edison interests, while T. C. Martin is recognized as the peer of electro-technical writers. By means of anecdote and memoir they intimately introduce to the reader the personality of the man and lead to an understanding of the unusual persistance and indefatigable energy by which his achievements have been accomplished.

His most important inventions and the ones to which the major portion of these two volumes are devoted have been in connection with the stock ticker, the telegraph, the telephone, the phonograph, the incandescent lamp and lighting system, the electric railroad, magnetic ore milling, Portland cement, motion pictures and the storage battery. Here is science sugar-coated for the layman, yet useful for the technician. Here are the cold hard facts about electricity attractively presented in an atmosphere of romance more thrilling than a novel, but withal a story of real life. What drama can be more powerful than this account of a poor boy who gradually forces himself to the position of a pioneer on the frontier of scientific investigation, making fortunes in a year and spending them in a week, yet always undaunted and always succeeding? The discovery of the Mesabi iron range nullified a decade of his work and two millions of his money expended in search of a magnetic process for milling of iron ore, yet this seeming failure has been the means of revolutionizing the manufacture of cement. The narrative account of each of these great inventions is ably supplemented by an appendix which gives their theory and practice. Concluding chapters briefly summarize the legion of other patents which he has been granted; describes his methods, his laboratories, his business ventures and the commercial side of his work as well as the litigation in which he has been involved and the recognition which he has been accorded. There is also a copious index which makes the book valuable for reference work. On the whole the facts are authentic, the details complete and the treatment inspiring.

Electricity, Experimentally and Practically Applied. By Sidney W. Ashe; 349 pages, 5x8; 422 illustrations. D. Van Nostrand Co., New York, and Technical Book Shop, San Francisco. Price, $2.00.

This book gives an excellent practical account of the action of the various types of electrical apparatus in ordinary use. The text is clearly written and logically arranged and most of the illustrations are of up-to-date machines. After a concise presentation of the intimate connection between magnetism and electricity, and a brief summary of the theory of direct current apparatus, the author illustrates and describes the more important types of primary and storage batteries, the action of electrolysis, the three wire system, electrical measurements, motors, lamps and meters. The last four chapters are devoted to an elementary explanation of the theory of alternating currents, the transformer, the induction motor and the rotary converter. Higher mathematics has been carefully eliminated and all explanations are illustrated by experiments so simply described that the manual may well be used by a student having no instructor. It is typical of the practical course of instruction usually given to those men working with and familiar with electrical apparatus, but not acquainted with its theory.

The Tesla High Frequency Coil. By G. F. Haller and E. T. Cunningham, 119 pages, 5x8, 56 illustrations. D. Van Nostrand Co., New York, and Technical Publishing Co., San Francisco. Price, $1.25.

Directions for the construction of Tesla high frequency coils are herein given, taking up successively the transformer, the interrupter, the condenser and the oscillation transformer, stating full details for winding and insulation as well as directions for assembling. The drawings and dimensions are intended for a 12-inch coil, specially designed to give a high frequency discharge at great volume. Its principal uses aside from wireless telegraphy are briefly illustrated, including directions for obtaining the more spectacular effects which astonish the visitors at our electrical exhibitions. The concluding chapter gives details for a 7-inch standard coil.

The Telegraphic Transmission of Photographs. By T. T. Baker; 141 pages, 5x7; 64 illustrations. D. Van Nostrand Co., New York and Technical Book Shop, San Francisco. Price, $1.25.

This volume brings together the history of the attempts that have been made to transmit photographs and pictures by means of the telegraph and briefly describes the selenium process of Professor Korn, the telautograph of the same worker, the Thorne-Baker telectrograph and the Belin telestereograph. In each case the apparatus employed is described and the results obtained illustrated. These systems have been from time to time described in the various technical papers but are here for the first time brought into one volume, whose convenience and comprehensiveness should commend it to those interested in this subject.

Dynamo Electric Machinery. By Samuel Sheldon and Erich Hausmann, 328 pages, 5x8; 210 illustrations. D. Van Nostrand Co., New York,-Technical Book Shop, San Francisco. Price, $2.50.

The fact that a book has reached the dignity of an eighth edition within less than ten years shows rather conclusively that it at least meets the requirements for which it was written, in this case a text book for engineering students. Since its initial publication, the great advance which has been made in the electrical world has made necessary the complete re-writing of all but the first two chapters which present elementary electrical and magnetic laws and facts. It deals only with direct current machines and is intended as supplementary to laboratory work. This text is so well and favorably known that a summary of its contents is unnecessary here.

Wireless Telegraph Construction for Amateurs. By A. P. Morgan; 188 pages; 5½x8; 147 illustrations. D. Van Nostrand Co., New York, and Technical Book Shop, San Francisco. Price, $1.50.

This is essentially a book of practical information regarding wireless telegraphy for the novice. After a brief treatment as to theory, the author takes up the receiving apparaus, illustrating various commercial instruments and diagrams for the construction of aerials. In the same manner all the apparatus necessary for the sending work is detailed, whereby the amateur may make his own induction coil, interrupter, transformer and condenser. Succeeding chapters deal with the various types of detectors which have been devised and present practical hints as to operation. By its use it is possible for anyone of average ability to construct and satisfactorily operate his own system.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS

R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

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CONTENTS

Additional Sources of Power

In these days of conversation about conservation and delightful theories about protecting natural resources for those who will follow us three or four thousand years hence, it is refreshing to know that new sources of power are constantly being found. It is but a few short years since California was handicapped by lack of cheap fuel, but how abundantly has this want been supplied from her mountain streams and the oil of her subterranean recesses. It is of general knowledge that westward from the one-hundredth meridian of west longitude the soil is underlaid in many places with incalculable quantities of lignite, but it is not so generally known that this much despised substance is susceptible of supplying cheaper power than the finest anthracite coal.

Recent tests at the Government fuel testing plant proved that lignite when used as a fuel in the gas producer can do more work, ton for ton, than the best Pennsylvania or West Virginia coal when burned under steam boilers. Coal utilized in a gas engine through the medium of the gas producer has been demonstrated to have more than double the practical efficiency as when used in the steam engine and boiler. Though these facts have long been known and have found extensive application in England and Germany, the prodigal American continues to waste high grade fuel for work which could be better done with lignite. The producer will handle any fuel which contains more than twenty per cent of combustible matter, so that there are also many other waste products, such as peat and beet sugar refuse which may be utilized for power.

These facts are vital to the industrial development of all the western states. North Dakota alone is estimated by the United States Geological Survey to have five hundred billion tons of lignite underlying a portion of its area. The same authority gives Montana three hundred billion tons, the San Juan field of New Mexico, one hundred and thirty billion tons, summarizing by the statement that the available aggregate of lignite and subterranean coals in round numbers is something more than a trillion and a quarter tons. Though these figures almost baffle our comprehension they show that there is no immediate danger of a fuel famine.

With this stupendous showing the importance of the gas producer and the commercial potency of electrical energy in the arid regions of America is too manifest to require comment. It makes possible the establishment of central electric power plants, each transmitting current throughout a region representing a huge circle whose circumference would be more than 1600 miles, these great plants using producer gas and fed by fuel cheaply procured from local lignite beds. This could be done at a price which would allow the use of electricity for every need of power, lighting and heating service. In a prophetic address before the Institution of Electrical Engineers, incoming President Ferranti outlined such a comprehensive scheme for the industrial rescue of Great Britain from the difficulties now threatening and which will in time also menace the prosperity of this country.

PERSONALS.

C. L. Cory has returned to his San Francisco office from Los Angeles.

H. R. Noack, of Pierson, Roeding & Co., is visiting at Portland and the Pacific Northwest.

George Cressey of the Modesto Gas Light, Coal and Coke Company, was a San Francisco visitor this week.

W. H. P. Hill, manager of the Monterey County Gas & Electric Company of Monterey, was a recent San Francisco visitor.

John Coffee Hays, general manager of the Mt. Whitney Power Company of Visalia, California, has returned from a trip to New York.

W. S. Heger, California manager of the Allis-Chalmers Company, is again at his San Francisco office after making a tour of Southern California.

A. H. Cheney, of the sales department of the Brooks-Follis Electric Corporation, has returned to San Francisco from a Northern California trip.

Joseph Victor Kunze, Atlantic manager of the Pelton Water Wheel Company, with headquarters at New York, is visiting the Pacific Coast offices.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company has returned to San Francisco from a trip to Bakersfield and vicinity.

A. H. Snead, superintendent of the Nevada, California & Oregon Telephone Company, with headquarters at Reno, was a San Francisco visitor during the past week.

Delos A. Chappell and Messrs. Dietert and Cain of the Hydroelectric Company of Bodie, have been spending a few days at San Francisco. Mr. Cain is one of the largest mine owners in the district.

A. A. Dittrick, recently with the Western Electric Company at Seattle, and formerly with the Cleveland Construction Company of Cleveland, Ohio, is at San Francisco, where he hopes to make permanent connections.

N. Ohno and K. Nishimura, mechanical engineers with the engineering department of the Japanese house of Mitsui & Co., are visiting the firm's San Francisco branch. They have been making inspections of electrical power installations and engineering plants in this country.

John F. Stevens, the engineer who has charge of the construction of J. J. Hill's new railroad projects in Central Oregon, was a San Francisco visitor during the past week. He was the first chief engineer of the Panama Canal and resigned that position to take a more lucrative one with the Metropolitan Street Railways of New York City.

Harris J. Ryan, professor of electrical engineering at Stanford University, will present a paper on atmospheric conductivity at the January meeting of the San Francisco Section of the American Institute of Electrical Engineers. This will be published in the January Proceedings of the Institute. Professor Ryan will also talk on this subject at the New York meeting on January 13th.

Paul Shoup, vice-president of the Pacific Electric Railway Company, has returned to his San Francisco office after spending two weeks at Los Angeles. It is announced that Mr. Shoup will in future be the directing head of this Southern Pacific interest. It is reported that the electric trackage of the system will be increased to about 1500 miles in the future, as practically all of the Southern Pacific's local steam lines entering Los Angeles will be changed over to electric roads. Both freight and passenger service will be operated from points as far distant as Bakersfield, 175 miles north of Los Angeles.

TRADE NOTES.

The Kellogg Switchboard & Supply Company has closed a contract with the Compania Telefonica de Sonora S. A., of Sonora, Mexico, for telephone equipment for the city of Hermosillo. The installation includes a 3-position magneto exchange with 300 lines equipped. A special feature is the new Kellogg 4-party harmonic selective equipment. Charles W. Forbes is general manager of this company, which has taken over the government concession for the entire system of telephone lines in the State of Sonora.

W. Motelius Price Company announce that it carries a complete stock at its Seattle warehouse of the F. H. Lovell Company's marine fittings and gauge glasses, the American Electric Fuse Compauy's products, and the Murphy Electricity Rectifier Company's rectifiers. They are also agents for the Electric Service Supply Company, Garwood Electric Company, Trenton Engine Company, Machen & Mayer Electrical Manufacturing Company, Queen & Company, The Powers Regulator Company, and the Delaware Hard Fibre Company.

The San Diego Electric Railway Company of San Diego, Cal., has just placed an order with the Westinghouse Electric & Manufacturing Company, Pittsburg, for two 1000-kw., 600-volt, 514 r.p.m. generators to be driven by Westinghouse Parsons low pressure steam turbines running at 3600 r.p.m. The generators and turbines will be connected through Melville-McAlpine reduction gears. In addition to this equipment, the Westinghouse Company will shortly ship one 1200 kw., 600-volt, 80 r.p.m. engine type D. C. generator to the same company.

NEW CATALOGUES.

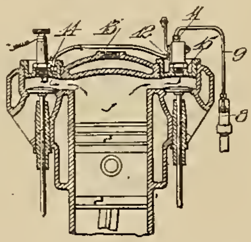
The Crouse-Hinds Company of Syracuse, N. Y., has issued a 9x12 catalogue devoted to panel boards and cabinets. The book is profusely illustrated in two colors and printed on heavy coated white paper, the 80 pages of catalogue being inclosed in an artistically embossed cover with cloth back. Each detail of construction is described tersely, and listings and prices of individual and assembled parts are presented clearly. Panels and cabinets also are listed separately and together.

The Western Electric Company has just issued bulletin No. 1116, describing magneto telephone sets and accessories. The bulletin contains 40 pages and is profusely illustrated with photographs. Several pages are devoted to the desigu and construction of wall and desk sets, and the No. 1317 type wall set is described with attention to the smallest details. The bulletin describes and lists backboards, batteries, battery boxes and gauges, binding posts, buzzers, condensers, cords, desk set boxes, desk stands, flexiphones and flexiphone arms, generators and generator boxes, gongs and gong mountings, hand sets, induction coils, number plates, protectors, protector blocks, fuses, micas and mats, receivers, ringers, switch hooks, test sets, transmitters and transmitter arms and brackets.

An instructive pamphlet, No. 1137 on the principles of construction and operation of watthour meters has just been issued by the Westinghouse Electric & Manufacturing Company. Though in the form of a descriptive circular, the pamphlet goes at some length into the question of rates and the theory of meters, and points out the importance of the various features and adjustments of modern meters, both a.c. and d.c. Even to one reasonably familiar with the subject, the pages on "Selection of Watthour Meters" will bring out valuable points often overlooked. The book describes the latest style of Westinghouse type C induction watthour meters,, with micrometer light load adjustment and permanent magnets so arranged as to be really permanent, both in position and strength. The "ball and jewel" type of bearing and other features are described and illustrated, also a method of meter testing without the use of a stop watch.

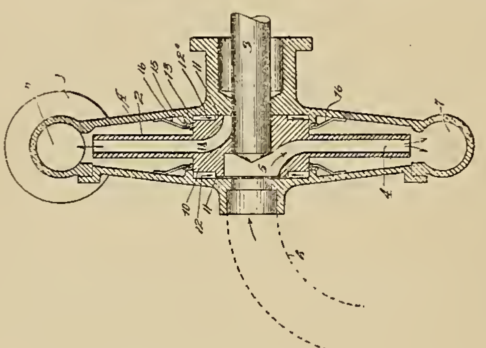
PATENTS

977,007. Gas-Engine-Starting Device. William A. Hansen, San Francisco, Cal. The combination with an internal combustion engine, and a main carbureter, of a supplemental vaporizer, a hydro-carbon supply device between the main carbureter and said vaporizer, and a controlling needle-valve, a



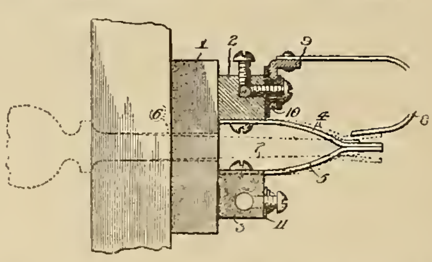
chamber, means for admitting air under pressure into said chamber, a pipe conducting gasoline through said chamber, said chamber having an annular exterior passage for the air, and a distributing chamber into which the mixture is admitted and from which it is delivered to the cylinders.

977,101. Centrifugal Pump. Ferdinand W. Krogh, San Francisco, Cal. The combination in a centrifugal pump, of a casing having central inlet and peripheral discharge passages, an impeller revoluble within the casing, the impeller having curved water ways connecting with the inlet passage and having a hub through the center of one side of which the



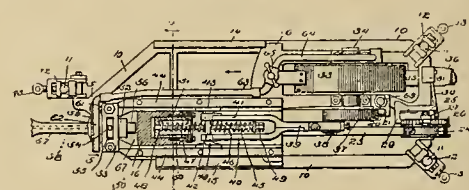
inlet ends of the water-ways open, said hub and the inner faces of the casing having annular flanges forming with the adjacent sides of the casing and hub, intermediate chambers, and said impeller having other passage-ways which are independent of the first-named ones and whose inner ends open through the side of the hub opposite to that through which the inlet ends of the first passages open, both of said passages leading outwardly through the periphery of the impeller.

977,061. Means for Measuring Current in Three-Phase Systems. Carl Wiler, Chicago, Ill., assignor, by mesne assignments, to General Electric Company. Means for measur-



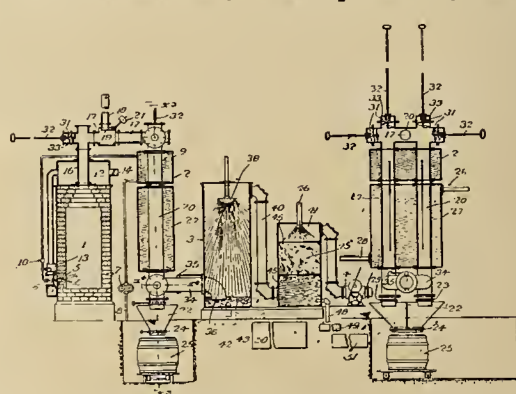
ing the current in each of the phases of a three-phase alternating current system, said means comprising a pair of jacks each provided with a pair of normally closed springs arranged to be opened by the insertion of a plug in the jack, a bar permanently connecting a corresponding spring of each jack, a second bar extending between said other springs and arranged to be electrically connected with either of the same when the plug is inserted in the corresponding jack, transformers included in the circuit of two said phases, each transformer having one terminal of its secondary connected to one of said last-mentioned springs, and a measuring instrument having one of its terminals connected to said first-mentioned bar and its other terminal connected to said second bar and to the other terminals of the secondaries of said transformers.

977,302. Water-Power Mining-Drill. Carl A. Hanson, Seattle, Wash. The combination with a main frame and means for supporting the same, of a second frame slidably mounted upon the main frame, means for manually advancing the second frame upon the main frame, said means including a ratchet



mechanism mounted on the main frame, a cable, and a spring connecting the ratchet mechanism with the second frame, a hammer mounted to reciprocate upon the second frame, a cross head mounted to reciprocate upon the second frame, yielding connection between the cross head and hammer, a drill in position to be struck by the hammer, and a motor adapted to actuate the cross head.

977,000. Process for the Production of Carbon-Black Together with Combustible Gas. Warren H. Frost and Joshua J. Nix, Los Angeles, Cal.; The process of producing carbon black together with combustible gas, which consists in producing a condition of suction in a combustion chamber, continuously supplying petroleum to said chamber, admitting a restricted quantity of air to said chamber to cause partial combustion of the petroleum, the condition of suction in the chamber being such that the resulting temperature is sufficiently high to substantially break up the tarry matter and



to cause the unconsumed petroleum to be decomposed substantially into combustible gas and free carbon, drawing off the combustible gas to maintain the condition of suction in the combustible chamber, and delivering such combustible gas, the petroleum being supplied to the chamber and atomized under its own expansive pressure, exposing the gas to the action of a cooling surface to separate carbon black therefrom, and removing the carbon black from such cooling surface.

INDUSTRIAL

HOUSEHOLD DEVICES FOR CHRISTMAS GIFTS.

Electric household devices are meeting with a rapidly extending use due to the efforts now being made to lift a large share of the burden of household toil from the shoulders of the long-suffering housewife and to the demand for a more sanitary method of preparing food.

Fig. 1. General Electric Combination Gift, consisting of Chafing Dish, Tea Kettle, Coffee Percolator, Toaster and Flat Iron.

Naturally these devices are becoming popular for Christmas gifts. Fig. 1 shows a combination gift consisting of a chafing dish, coffee percolator, tea kettle, toaster and flat iron,

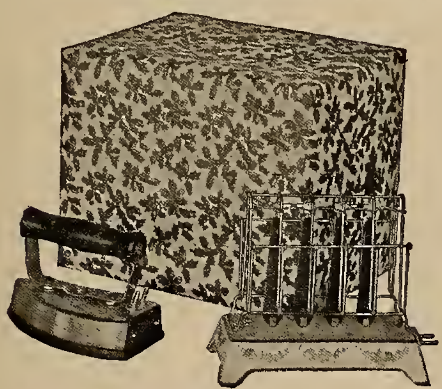


Fig. 2. General Electric Toaster and Flat Iron.

all of General Electric make, while smaller combination gifts is shown in Fig. 2.

General Electric heating devices employ heating elements made of calorite, a wonderful new alloy discovered after years of scientific investigation in the extensive research laboratories of the company.

These devices form acceptable gifts and in addition the whole household will enjoy the benefits resulting from their use for years to come. A man cannot give his wife a more suitable present than these household devices, which make her household duties lighter and more interesting.

MOTORS PROVE VERY SUITABLE IN VOCATIONAL SCHOOL.

The accompanying picture was taken in a wood-working shop that is a model of its kind. The shop is part of the Vocational School for Boys, New York City. The various machines are driven by individual electric motors, a method that absolutely safeguards the boys against mishaps that occur so frequently in shops where long belts and line shafts are present.

The illustration shows how well electric motors lend themselves to a layout of machinery that precludes accidents. Of course, besides the safety afforded, the motors are economical in their operation, and greatly add to the convenience of the students. Furthermore, if any of the boys are particularly ambitious and desire to work outside of the scheduled hours, they can very easily utilize any one of the machines without requesting that the whole equipment be put into operation.

The Vocational School for Boys is intended for boys who desire an education that will prepare them for industrial work as distinguished from office work. Pupils are afforded an opportunity to learn the elements of a trade, and to study architectural, free-hand and mechanical drawing, while continuing their general education along lines that will best fit in with this work. Everything necessary for the work is supplied by the school; there are no charges of any kind. The course is designed to cover one year or two years of work.

The boys who know definitely just what trade they want to follow, are permitted to start at that work, and devote most of their time to it. Those boys who have not decided on any special work are permitted and required to take several lines of trade work. The instructors then advise the boys intelligently and guide the boys to a wise choice. After this has

Individual Motor Drive for Machine Tools.

been done, the pupils devote their time to the trade selected. All the instruction is individual, although the boys work in groups. There are no regular "classes," as the term is ordinarily used. Each boy is a unit, and he progresses as rapidly as his ability will permit.

The vocational courses offered include woodwork, metal work, printing and bookbinding.

The divisions of woodworking covered are: House carpentry and construction, cabinet making and bench work, wood turning, pattern making in wood, and use of wood milling machinery.

The woodworking machinery includes two rip and cut-off saws, a universal saw, a 4-roll single cylinder cabinet surfacer, a hand planer and jointer, a jig-saw, and a knife grinder. Most of this was made by the Oliver Machinery Company, Grand Rapids, Mich.

The motors are of the induction type and operate at 1700 r.p.m. on 220-volt, 2-phase, 60-cycles. The motors were made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

AN INTERRUPTER FOR RAILROAD TELEPHONE WORK.

A new interrupter, designed especially for railway telephone service, has just been placed on the market by the Western Electric Company. This interrupter, known as the

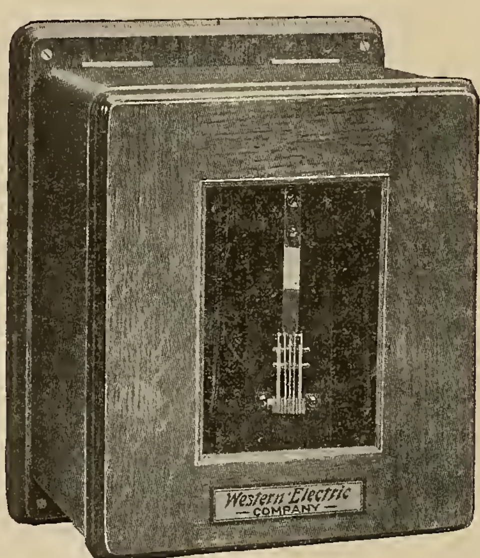


Fig. 1. No. 62-A Interrupter Showing Glass Window.

62-A, is especially adapted for use in block towers, where the operators are so busy that they do not have the time to call other stations by means of a hand generator. It is also especially well adapted for use on yard lines where several telephones are connected to the same pair of wires. It is not limited, however, to this class of work, but is efficient in all code ringing work, as the signals, due to the sensitive mechanism, can be made very clear and distinct.

The No. 62-A interrupter, a closed view of which is shown in Fig. 1, is intended to be mounted normally upon the wall in a vertical position in the same manner as a telephone set. The set is enclosed in a neat, well-constructed oak cabinet, provided with a hinged cover. This cover is provided with a glass window, through which the operation of the mechanism can be observed when the cover is closed. The mechanism is mounted upon the base of the cabinet and is readily accessible for adjustment, test and inspection.

The interrupter is operated by means of a key, or push button, which closes a battery circuit containing four to eight dry cells. The number of cells necessary depends upon the number of bells it is desired to ring. It is recommended that five dry cells be used, which will efficiently ring fourteen 1000 ohm ringers, or sixteen 2500 ohm ringers, on a line of 500 ohms resistance, an equivalent of about a thirty-mile metallic circuit of No. 12 B. & S. copper wire.

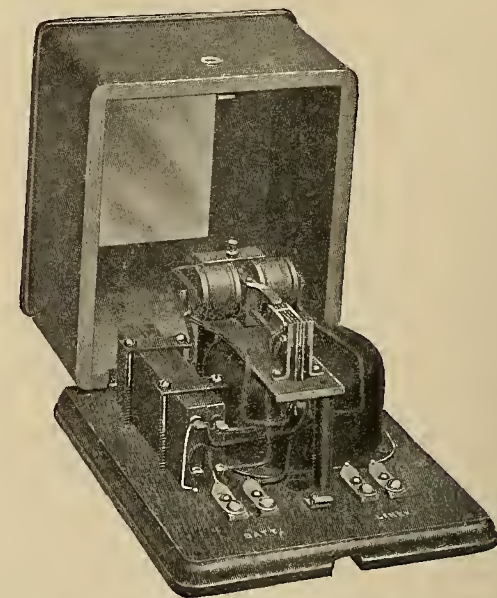


Fig. 2. Open View Showing Mechanism.

The interrupter is so adjusted that it responds at once when the key is pressed, closing the battery circuit.. This insures a very economical current consumption, as the interrupter is only in action when the battery circuit is closed.

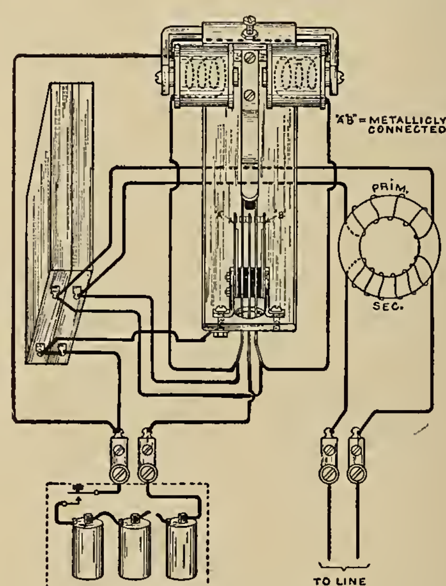


Fig. 3. Circuit Diagram.

The mechanism is practically noiseless and sparkless. All circuit contacts are of platinum. While the mechanism is sensitive, it is built in a substantial manner which insures long service and low maintenance. The circuit diagram shown in Fig. 3 shows the simplicity of the circuit and the ease with which it can be connected.

TRADE NOTE.

The Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., has recently booked several large orders for small power motors. These include 1000 graphophone motors for the American Graphophone Company; 500 ¼ h.p. special a. c. motors for the Electric Renovator Manufacturing Company; 500 1-8 h.p., 110-volt, 60-cycle DA motors for the 1900 Washer Company, 450 1-15 h.p. DA motors for the Wayne Manufacturing Company, and 624 ½ h.p. a. c. motors for the Hobart Electric Company of Troy, Ohio.

NEWS NOTES

FINANCIAL.

KINGSBURG, CAL.—The Board of Trustees passed an ordinance providing for the issuing of bonds of the city of Kingsburg in the amount of $26,000 for the proposition of paying the cost of a certain municipal improvement to wit: For the proposition of paying the cost of the acquisition, construction and completion of a municipal water plant for supplying the city of Kingsburg with water for domestic and other use and for protection against fires, including water bearing lands, works, pumps, reservoirs, pipes, mains, laterals, fire hydrants, cut-offs, taps and service pipes.

MONTEREY, CAL.—The controlling interest in the Monterey County Gas & Electric Company has been bought by interests represented by F. G. Baum of San Francisco, who is to have entire management of the electric and gas plants at Monterey, the electric railway between Del Monte and Monterey and the electric light, gas and water plants at Salinas. The steam plant at Salinas is to be taken out of commission and a tie line built from the steam turbine plant at Monterey, an assessment of $3.00 per share having been levied to carry on the work. Extensive improvements are also to be made in the Salinas water system. The purchase price is believed to be about $900,000.

INCORPORATIONS.

CONNELL, WASH.—The Enterprise Telephone Company has been organized by W. H. Welch to build a line south of the city.

SEATTLE, WASH.—The Bellevue Electric Company, capital $500,000, has been incorporated by E. P. Morgan, H. L. Collier and Frank J. Maron, to construct an electric line from Bellevue to Lake Sammamish.

TACOMA, WASH.—Articles of incorporation have been filed with the county auditor by the Mt. Tacoma Telephone & Telegraph Company, capital stock $3000. The trustees are A. E. Dye, Isabella Dye and Charles C. Biggs.

ONTARIO, CAL.—The West Ontario Mutual Water Company has been incorporated with a capital stock of $10,000. The directors are: N. H. Garrison, J. W. Fulton, R. B. Campbell and others. The purpose of the new company is to purchase, develop, sell and distribute domestic and irrigating water.

SPOKANE, WASH.—The Washington Consolidated Telegraph & Telephone Company, capital $1,000,000, has been incorporated by Fred Howes of Burlington, Vt.; H. H. Reynolds of Peterboro, N. H., and C. M. Cooley of Spokane. It is proposed to acquire holdings of a number of smaller telephone companies in this vicinity.

LOS ANGELES, CAL.—H. E. Huntington has created a new corporation, The City Railway Company of Los Angeles. The mission of the new corporation is to build extensions and new lines for the Los Angeles Railway Corporation and the Huntington Company, controlling all of the city street car lines. The directors of the new company are Howard E. Huntington, G. C. Ward, C. A. Henderson, J. E. Brown, W. E. Dunn, S. M. Haskins, Albert Crutcher.

PAYETTE, IDAHO.—Articles of incorporation have been filed here for the Salmon Falls Light & Power Company. The principal line of business of the company is furnishing light and power for flour mills and saw and planing mills. The capital stock is $100,000, divided into 1000 shares of the par value of $100 each. Mr. Wright states that they have a power site whereby they can develop from 2300 to 3000 horsepower and that they can obtain a working head of one hundred and twenty-three feet when fully developed.

SAN FRANCISCO, CAL.—Articles of incorporation of the Western States Gas & Electric Company, have been filed, in which the capitalization of the corporation is fixed at $15,000,000, divided into $10,000,000 preferred and $5,000,000 common stock. The organizer of this corporation which proposes to operate in California on a large scale, is the firm of H. M. Byllesby & Co. of Chicago. The purpose of the corporation, as stated by the Byllesby representative here, Fred W. Stearns, is to take over the gas and electric companies which this firm has already purchased in California and such other properties as they expect to acquire in the future. The principal holdings of this firm in California at present are the Stockton Gas & Electric Company, which was recently purchased, and the Richmond Electric Company. Negotiations are pending for the acquisition of the Eureka Gas & Electric Company. The Byllesbys also own the San Diego gas works. In the Northwest they have several properties, including the gas company at Tacoma.

TRANSPORTATION.

VICTORIA, B. C.—The B. C. Electric Company has located the line of its proposed road to the Saanich peninsula.

SAN RAFAEL, CAL.—George D. Shearer has been granted a franchise to operate an electric street car system in this city.

SAN FRANCISCO, CAL.—The Board of Works awarded a contract to the Pennsylvania Steel Company to furnish a consignment of rails for the Geary Street Railroad, the price being $88,943.

ALBANY, ORE.—The City Council of Lebanon has granted the Albany and Interurban Railway Company a franchise through that city. This line will run from Albany to Sweet Home via Lebanon, thence across to Holley, down to Brownsville and back to Albany.

VANCOUVER, B. C.—The survey has been completed for the construction of the proposed electric railway system from Bakerville to Fort George, distance 150 miles. Mr. Murphy of Vancouver is in charge and construction work will start in the spring. A water-power plant will be constructed to supply electricity.

TUCSON, ARIZ.—To make arrangements for the construction of the street car line extension from the present Third street terminus to a point on Speedway about two miles from the city, E. R. Sanderson, a representative of the controlling company, of which the Tucson Rapid Transit Company is a subsidiary, is on his way to Tucson from the East.

OAKLAND, CAL.—Rejecting the application of the Oakland Traction Company for a franchise on several streets of the city, the Council has voted not to consider the matter until the railroad company had segregated its requests. The application was for a franchise on portions of Hopkins street, Peralta avenue, San Pablo avenue, Market street, Fifty-fifth street, Clay street, Eighth street, Thirteenth street and Washington street. Councilman Albert H. Elliott challenged the form of the application, which he said would call for a blanket ordinance. Admitting that a franchise on Hopkins street

might be desirable be stated that there might be some objection to converting Clay street into a railway thoroughfare. Any further application by the traction company for its franchises will now come under the provision of the new charter. The granting of a 50-year franchise would be thus blocked until July 1, when the charter goes into effect.

PORTLAND, ORE.—The Portland Railway, Light & Power Company is preparing to improve its car service on the east side by providing greater power. Plans for the construction of a sub-station at East Sixtieth and Stark streets have been filed. The new power plant will be housed in a one-story brick building. The company will expend about $40,000 for rotary generators and other electricity making machinery to be installed in the new station.

SACRAMENTO, CAL.—The Northern Electric Company, operating from Sacramento to Marysville and Chico, is closing a deal for the purchase of the George Bryte ranch in Yolo county across the Sacramento river from Sacramento, for a terminal to be known as West Sacramento. The terminal of the road will be on the other side of the river and shops, switching yards, etc., will be laid out there. Wharves, docks and warehouses will be built along the river front, which the company owns.

SACRAMENTO, CAL.—In accordance with its franchise the Northern Electric Company will, it is announced, begin its local service on Eighteenth and D streets and Eighth and J streets. The tracks of the company, going out I street have been laid, and according to the provision of the franchise, the company must start a 20-minute service on the line. Melville Dozier, assistant general manager of the company, says that a style of car the same as used on the Los Angeles street car system will be used by the Northern Electric Company.

TRANSMISSION.

HANFORD, WASH.—The transmission line from the local plant of the Pacific Light & Power Company will probably be extended south to Richland and possibly to Kennewick.

CHEHALIS, WASH.—It is reported that blue prints and plans are in progress for the construction of a new power plant in the Big Bottom country for the Valley Development Company, work to start February 1.

TACOMA, WASH.—Pierce County Commissioners have granted Seattle-Tacoma Power Company a franchise to string a high-power transmission line five miles long from the south boundary of Puyallup Indian Reservation to North Puyallup.

AMERICAN FALLS, IDAHO.—Final arrangements have been made for increasing the capacity of the American Falls plant of the Idaho Consolidated Power Company from 3000 to 30,000, work to commence in the near future. Gov. James H. Brady is president of the company.

GREENVILLE, CAL.—The Indian Valley Light & Power Company is about to make extensions in their transmission system. Taylorsville, Crescent and Seneca will be benefitted by these improvements. The company is having plans made for a larger power plant. O. C. Pratt, Crocker Building, San Francisco, is general manager.

WINNEMUCCA, NEV.—George Wingfield has completed the purchase of three ranches on the South Fork of the Humboldt river, with all water rights connected with them, and intends to begin the construction of a big power plant for the operation of a reduction plant for the Buckhorn mines. He will first build a dam 100 feet high, which will cost $150,000 and which will back the water up into a big reservoir. This will provide all the water necessary for generating electric power.

WHITE BLUFFS, WASH.—Construction work on the power line from the Hanford plant to Richland and Kennewick will be started this winter to furnish power for irrigation along the Columbia River from this place to Priest Rapids.

SONORA, CAL.—The National Park Electric Power Company has filed a complaint in the Superior Court of Tuolumne County against the city and county of San Francisco to restrain it from diverting 10,000 miner's inches of water immediately above the plaintiff's point of diversion near the Yosemite National Park boundary. The company claims a flow of 25,000 inches in Tuolumne river and if San Francisco is allowed to divert her claim of 10,000 inches, the plaintiffs will be wholly deprived of their rights.

ILLUMINATION.

CLARKSTON, WASH.—Wm. H. Galrani, representing the Pacific Light & Power Company, has applied for a gas franchise in this city. If the franchise be granted, the company plans to begin construction within six months.

TWIN FALLS, IDAHO.—The Council has passed an ordinance granting to Earl E. Miller, the right to construct and operate works for the manufacture of gas, and the laying down of gas mains, pipes, and conduits in and along several streets, alleys, avenues and public places for the distribution of gas in Twin Falls.

HERMISTON, ORE.—An ordinance has been passed granting to B. A. Chisholm and G. A. Chisholm, a franchise for erecting and maintaining and operating an electric lighting and power system, and erecting and maintaining poles and wires in, along and upon and over the alleys, streets and public grounds of the city of Hermiston.

WATERWORKS.

YUCAIPA CITY, CAL.—General Manager Atwood of The Land & Water Co., is having plans made for the extension of the water system.

MEDFORD, ORE.—The City Council has awarded to James A. Mear of Portland the contract for the construction of the new water system.

PORTOLA, CAL.—The Portola Water Company has applied to the Board of Supervisors for a franchise to lay pipes and water mains in the streets and alleys of the town of Portola.

OAKLAND, CAL.—This company has let a contract to Crane & Company for 30 miles of pipe, which will mark the beginning of the system in the East Oakland division. The shipping of this material is to commence within three days and the work of installing the pipe will begin as soon as it arrives. It will vary in size from 4 to 12 inches.

SAN LUIS OBISPO, CAL.—The action by the Board of Trustees at their meeting last week in accepting the proposition, made to them by Frank Tate, who owns lands and rights needed by the city of San Luis Obispo for a greater water system, shows a fine prospect. It will permit the trustees to proceed at once with the work of building a new reservoir.

PROSSER, WASH.—Secretary Ballinger has awarded the contracts for the work on the Prosser division of the Sunnyside unit of the Yakima irrigation project as follows: Orrin H. Stratton of Spokane, four bridge spans, $12,000; Bernard Bros., of Prosser, trench and canal excavations, $18,830; Pacific Tank & Pipe Company of Portland, wood stave pipe, $18,972. The diversion dam and steel flumes will be built under force account.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 25 | SAN FRANCISCO, DECEMBER 17, 1910 | PER COPY, 10 CENTS

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

JOURNAL OF ELECTRICITY
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VOLUME XXV | SAN FRANCISCO, DECEMBER 17, 1910 | NUMBER 25

SPOKANE'S ELECTRICAL PUMPING STATION

BY ALEXANDER J. LINDSAY.

The question of water supply for any municipality is an important problem. This is especially true if the city is rapidly increasing in population and provision must be made for future growth. One of the best examples illustrating this problem is the city of Spokane, Washington, which has just completed the fifth addition to its pumping stations within 26 years.

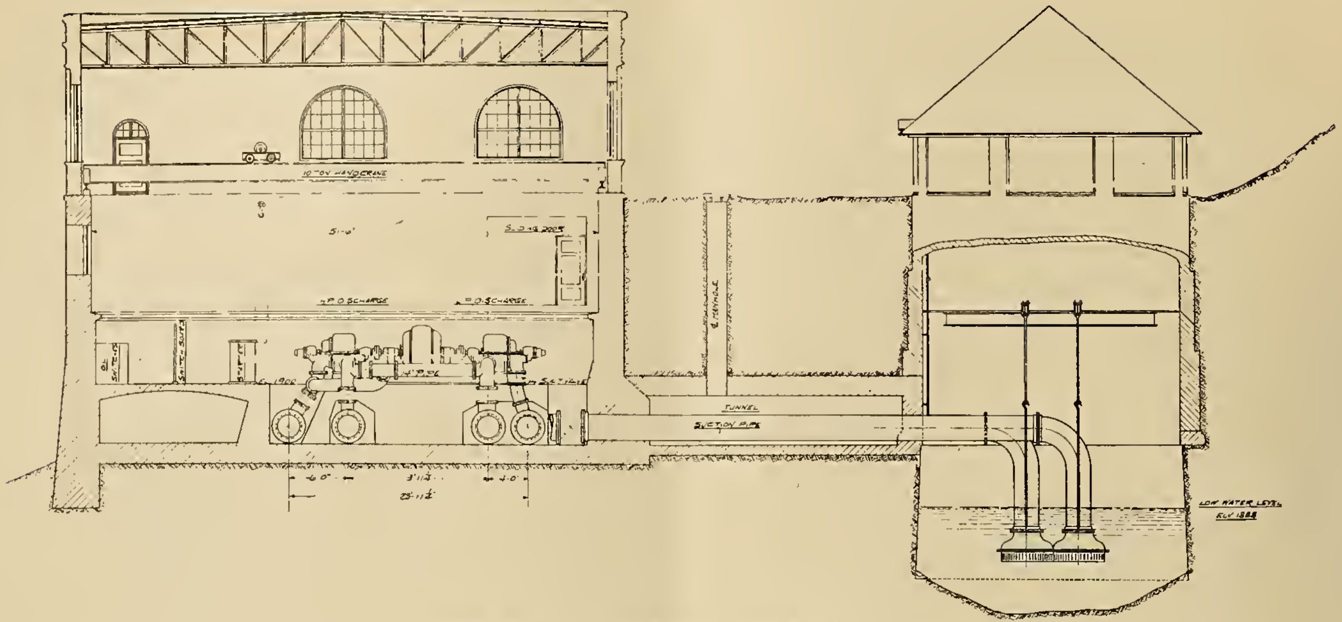
The growth of the city was up the river toward the east and the city grew so rapidly that in 1894 the original station had become so inadequate and the waters of the river so exposed to pollution that it became necessary to build a better and larger plant five miles above the center of the city. At this point the river had a natural fall of about 14 ft. At the upper

Exterior of Spokane Pumping Station, New Electrically Operated Addition On the Right.

end of this fall a rock-filled dam was built which somewhat increased the head and also provided a certain amount of storage. The water from this pond was carried through an earthen ditch for about a quarter of a mile to the gates immediately above the pumping station. From here the water was conducted by means of riveted steel flumes, 12 in. in diameter, to a series of vertical turbines, which were connected to pumps on the floor above by means of shafting and gearing. As this plant was far above the city the river water was absolutely free from contamination. The plant had a capacity of 10,000,000 gal. daily, which at that time was considered ample for Spokane for many years to come.

The adequacy of the water supply was based upon the experience of eastern cities and their normal factor

The original settlement of Spokane was made on the Spokane river at the site of Spokane Falls. The original public water supply was built in 1884, and consisted of a small pumping plant situated in a flour mill. A few hundred feet of pipe were laid through the most populous part of the village. These pumps had a capacity of 350,000 gal. per day and were operated by hydraulic turbines which received their power from Spokane Falls. It is interesting to note that this original equipment is still in service doing duty as a portion of the newer and enlarged system. It serves to supply water from the low pressure system to the highest points of the city, which have rapidly grown as a residence section. However, these will soon be displaced by motor driven two-stage centrifugal pumps, which are to be installed.



Cross Section of Spokane Pumping Station.

of growth. But Spokane grew much faster than the ordinary community and as early as 1898 it was necessary to add a new 4,500,000 gal. pump. This addition helped out temporarily, but in another four years it was necessary to add two 2,500,000-gal. pumps. These were driven by the same turbines which operated the original pumps for it was found that the wheels had ample capacity to carry the added load.

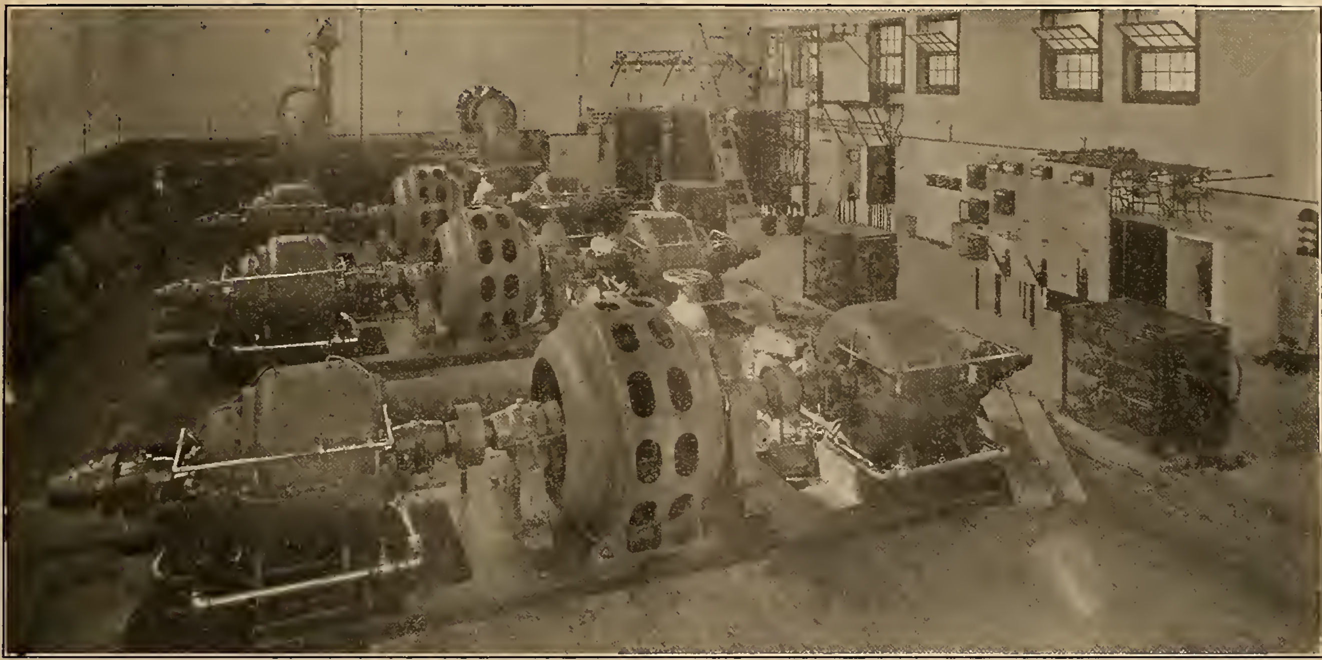
As the city grew, the hills south of the business section were soon occupied and, as the elevation of these was too great to be served by the same system which furnished water to the rest of the city, it became necessary to build two auxiliary pumping stations, one at Fifth avenue and Pine street and the other on Bishop Court near Monroe street. These supplied 2,500,000 gal. a day from the low pressure system to the hill section. These pumps were driven by electric motors. An attempt was made to instill high pressure pumps in the main station on the river bank but it was found that the old low pressure force main was not capable of withstanding the high pressure necessary to reach the hill sections of the city. At the time this attempt was made a new 30 in. riveted steel low pressure force main and a 20,000,000 gal. reservoir were built for the low pressure service and four 2,500,000 gal. pumps were installed in the river station. The addition of these pumping units carried the total capacity of this system up to 29,500,000 gal. per day and the low pressure system of the city was in splendid shape so far as quantity was concerned.

During all this time the valley of the Spokane river was being rapidly settled and the small town of Coeur d'Alene, situated where Lake Coeur d'Alene empties into the Spokane river, was rapidly becoming a city. This condition existing above the point where the water supply for Spokane was secured naturally tended to jeopardize its purity and city officials eventually found it necessary to condemn the source of water supply. At first it seemed probable that a new and entirely different source would have to be sought and the existing pumping stations abandoned.

During the construction of the up river pumping station it became necessary to dig pits for placing foundations and it was found that the water rose in these pits to a considerable height suggesting that there was a source of water supply either entirely separate from the river or else being supplied by infiltration. When it became necessary to seek a new supply a thorough investigation of the quantity and character of the underground water supply was made. Test wells were sunk at various points from Coeur d'Alene Lake down the river to the water works. Analyses of the water obtained from these wells showed it to be different from the water of the Spokane river. It was clear and pure and the only objectionable feature was the hardness. It was thought that a sufficient supply could be obtained from this source, but to make certain before too great an expenditure was made a large well 30 ft. in diameter was excavated back of the main pumping station. Two centrifugal pumps with a capacity equal to that of all the pumping machinery in the city were connected to this well and operated for a long time. While the level of the water in the well was lowered to some extent during pumping, it immediately rose when the pump was shut down and it was evident that the well had more than sufficient capacity to amply supply the city. This well was connected to the pumps in the river station and this supply was substituted for that from the river.

In the spring of 1908, the demand for water having again reached the capacity of the installed pumps, the two remaining wheels in the old station were loaded with two additional pumps of 2,500,000 gal. capacity each bringing the total capacity of the station to 24,500,000 gal. per 24 hours. While this helped out temporarily it was apparent that additional facilites would have to be supplied and plans were, therefore, put under way to meet the requirements.

It was decided that it would be best to dig a new well tapping the underground supply and to build an electrically operated pumping station, as the power supply obtained from the river was in use to its limit. The installation of these three motor driven centrif-



Motor--Driven Centrifugal Pumps in Spokane Pumping Station.

ugal pumping units has just been completed and is of particular interest as demonstrating the possibilities of this class of machinery for supplying water to large municipalities.

Pumping Station.

The new pumping station, which is entirely independent of the older station, is absolutely fire proof, being built with concrete foundations and steel and brick super-structure. It is supported on piling capped with a timber grillage all of which is below low water mark. The floor of the pumping station is itself 4 ft. below high water mark. In order to insure water tightness the basement floor and the walls, to a height of 7 ft. were made water proof by the use of asphalt felt and asphaltum. The interior walls are also made more impervious to the inseepage of water by being plastered with a coat of neat cement which also improves their appearance. The interior dimensions of the station are approximately 51½ ft. by 81½ ft.

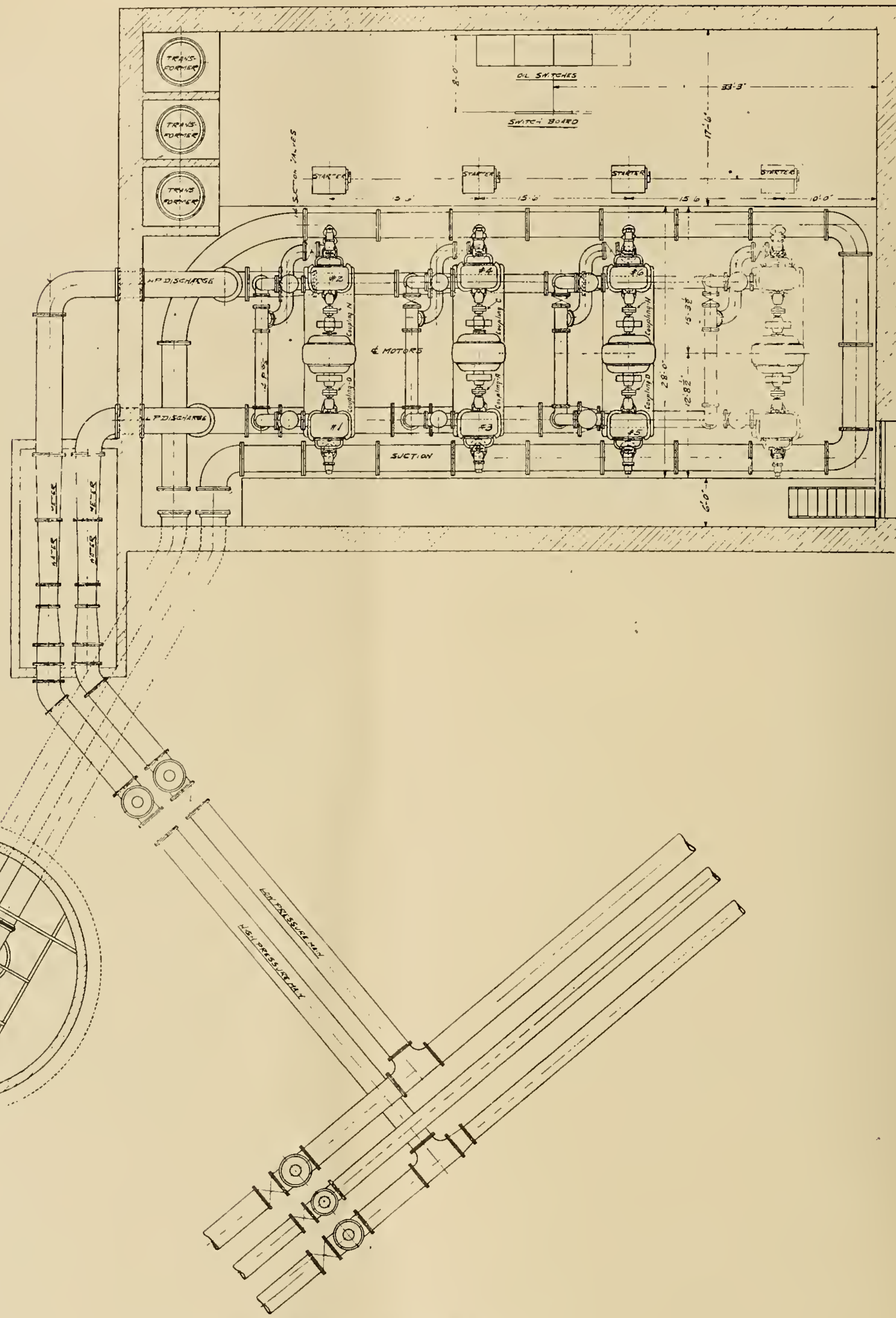
The three pumping units now installed are placed along one side of the station with their shafts parallel to each other and at right angles to the side of the station, as shown in the accompanying drawing. They are spaced 15 ft. 6 in. on centers. Each unit consists of a 900 h.p., 3 phase, 60 cycle, 2300 volt, 880 r.p.m. induction motor direct connected to two 14 in. two-stage centrifugal pumps.

Inasmuch as this equipment is representative of the most advanced procedure in this class of pumping equipment, a detailed description of both the pumps and motors may be interesting. Each centrifugal pump is of the Allis-Chalmers two-stage single end suction, horizontal shaft type. It is supported by brackets, cast integral with the casing, which rest upon and are bolted to a base plate. The shaft is made of open hearth steel and is amply large to carry the maximum loads without serious deflection. The impellers, which are of the enclosed type, are made entirely of bronze, and are fastened to the shaft by means of a feather key and nut. A bronze sleeve is also used to protect that portion of the shaft exposed to the action of the water. A stationary guide passage is placed between the two impellers, its function being to take the water from the tips of the vanes of one impeller and deliver it through suitably shaped passages to the inlet side of the succeeding impeller. The last impeller discharges in a radial direction through guide vanes into the casing. A balancing disc, connected with both the suction and discharge sides of the pump, maintains a practically perfect running balance. The bearings are of the ring oiled type lined with composition and the oil is supplied from a large oil reservoir. Stuffing boxes on both the discharge and suction sides of the pump are provided with bronze water sealing rings to prevent ingress of air.

The motors are of Allis-Chalmers standard design. They receive 3-phase, 60 cycle current at 2300 volts and will deliver 900 h.p. when making 880 r.p.m. The laminations, from which the stator core is built up, are suported in a substantial cast iron yoke which holds them securely in position. Cored openings are provided in this yoke and allow free circulation of air around the core and coils. Large ventilating ducts are provided. Special care is taken with insulation, and the copper is so designed as to give a very cool running motor.

The starting devices furnished with each motor include a bank of cast iron resistance grids mounted in an expanded metal case and arranged for connection with the collector rings. The resistance of the grids is such that a period of two minutes may be consumed in bringing a motor up to full speed with a temperature rise in the resistance not exceeding 175 degrees. The starters cut out this resistance in steps to secure proper acceleration of the motor. The collector rings are short circuited by a manually operated device when the motor is up to full speed.

Heavily insulated lead covered cables placed in the concrete floor connect the motors to the switchboard. Similar cables carried in conduits in the wall



Plan of Spokane Pumping Station.

of the building connect the transformers to the switchboard.

As will be noted by reference to the drawing, the switchboard is situated at one side of the station with the high tension oil switches in concrete cabinets back of it. The transformers are placed in one corner of the room. The switchboard is made up of four panels of blue Vermont marble mounted on an iron frame work which leaves a space of 25 in. between the bottom of the board and the floor. On the switchboard are mounted an ammeter, an integrating wattmeter, a volt meter and various other necessary instruments. Three 1000 k.v.a oil insulated water cooled single-phase transformers change the 13,200 volt line

current to 2300 volts for the station service. Taps are provided on both windings which give approximately 3. 6 and 9 per cent lower voltages. Transformers are connected in delta with a grounded neutral so that if one should fail it can be disconnected by means of switches and the station operated at one-half capacity on the two remaining transformers.

Piping.

From the supply well two suction pipes, arranged with foot valves, lead to the station and form a loop around the pumps. If it should be necessary at any time to repair one of these lines the total water supply of the station can be taken from the other. The suction pipes are carried from the well to the station through a concrete tunnel which is sufficiently large to allow for inspection and repair of the piping. The two 30 in. suction pipes are of riveted steel with flanged joints.

The discharge pipes are all of cast iron and are arranged with flanged joints throughout. By examining the drawing showing the station layout it will be seen that ordinarily both pumps of a set will discharge to the low pressure main. With this arrangement each unit has a capacity of 12,000,000 gal. per 24 hours against a head of 260 ft. However, in case of fire or other necessity for a higher pressure, the discharge from one pump of the unit can be connected to the suction of the other pump in which case the discharge of the second pump is led to the high pressure main. Under these latter circumstances the units have a capacity of 7,500,000 gal. per 24 hours against a head of 430 ft. Venturi meters are placed on the discharge of both the high pressure and low pressure lines.

Although the station was designed for four units only three have as yet been installed and the fourth will be placed in position when needed. After operating the station for a short time in a preliminary way to properly make adjustments, it was put in regular service and has been delivering water to the city for about two months. Every one who has been connected with the work has been extremely gratified with the success which has attended this electrical pumping equipment. The pumping units operate with practically no vibration and are easily regulated to maintain any desired pressure.

ELECTRIC VEHICLE PUBLICITY.

The Electric Vehicle Association of America has appointed a publicity and advertising committee whose purpose is to increase the use of the electric vehicle by advertising in the popular magazines and the trade publications. Money for this purpose is to be solicited from central stations on the basis of 1/25 of 1 per cent of the gross income of each company, a like amount also being anticipated from manufacturers. This committee consists of N. F. Brady, Samuel Insull, J. B. McCall, C. L. Edgar, W. W. Freeman, Charles R. Huntley, Alexander Dow, George H. Harries, Samuel Scovil, F. W. Frueauff, H. M. Byllesby, J. G. White, A. H. Ford, T. N. McCarter, Thomas Dolan, R. F. Pack, Arthur B. Lisle, Marcy L. Sperry, R. M. Searle, John B. Miller, John A. Britton, Alton S. Miller, G. W. Brine.

WATER POWERS OF SOUTHERN WASHINGTON.

Water Supply Paper 253 from the U. S. Geological Survey and written by J. C. Stevens is the first of a proposed series dealing with the water powers of the streams flowing from the Cascade Range in Washington and Oregon. Perhaps no area in the United States presents more favorable opportunities for water-power development than that traversed by the Cascade Range. The general elevation of the summit of the range is from 6000 to 8000 feet, and many of its peaks extend into the region of eternal snow. Among these peaks are Mount Baker (10,827 feet), Mount Rainier (14,363 feet), Mount St. Helens (9750 feet), Mount Adams (12,307 feet), Mount Hood (11,225 feet), Mount Jefferson (10,300 feet), Mount McLaughlin or Pitt (9760 feet), and Mount Shasta (14,380 feet). The streams draining this range have steep slopes and are fed during the low-water period by the many snow banks and glaciers that mantle the high peaks or by the liberal supplies of ground water. The precipitation on the area is abundant, although its distribution is by no means uniform. The streams possess the requisite properties of water-power development—rapid fall, abundant water, and comparative uniformity of flow; and the almost unlimited resources of timber, mines, and soil, as yet hardly touched, afford a promising market for these water powers and fixes for them a high potential value.

The primary source of rainfall in the Pacific States is evaporation from the Pacific Ocean, the water vapor being carried over the land by prevailing westerly winds. Whenever the moisture-laden air is cooled below the point of saturation, rain falls, and no precipitation can occur unless the air is thus cooled. The temperatures over the ocean are not nearly so variable as those over the land. In summer the land is relatively much warmer than the ocean, while in winter the reverse is true. Hence the general tendency is for the water vapor to be carried eastward over the mountains in summer and to be precipitated on them in winter. Thus we have the wet and dry seasons.

When the air in its eastward course encounters the western slope of the mountain ranges it is deflected upward into regions of diminished pressure. The resulting adiabatic expansion cools the air and the water vapor is precipitated. Thus the rainfall on the windward side of the range is much greater than on the leeward side, while the maximum rainfall probably occurs just over the divide. The summit of the Coast Range receives about 150 inches of rainfall in a year and the Cascade Range about 100 inches. Only about 5 per cent of this falls during the summer months, so that during this period the streams draw upon water stored in the ground and in snow banks and glaciers during the previous winter. The low-water period therefore occurs just before the fall rains begin.

The area treated in this paper comprises the drainage basins of Klickitat, White Salmon, Little White Salmon, Lewis and Toutle rivers and is located in the southern extremity of the Cascade Range in Washington. The broad crest of this portion of the divide lies wholly within the Columbia and Rainier national forests, within which all streams of the region have their sources.

Special investigations made on these streams during the season of 1909 form the basis for this report. Each of the streams investigated is considered in detail. Descriptions of the several drainage areas are given, together with profiles of the streams and principal tributaries, discharge data, and a detailed compilation of the water powers capable of being developed at the average minimum stage. The report must be considered rather as an inventory of the latent power resources of this section than as an engineering report on feasible power projects. It is, however, based on engineering principles, and the present practices of water-power development have been given due consideration.

The field investigations were made by two parties of four men each, which were in the field from July 1 to October 1. One party, in charge of H. D. McGlashan, junior engineer, United States Geological Survey, made the surveys of Klickitat, White Salmon, and Little White Salmon rivers. The other, in charge of C. W. Harris, instructor in hydraulics, University of Washington, made the surveys of Lewis and Toutle rivers. Warren O. Harmon, Charles Leidl, F. W. Whalley, and C. F. Holmes, students at Washington State College, were employed as rodmen. A map and a profile of each stream were made and data were gathered as to the discharges at critical points in each drainage area. From these data the undeveloped water-powers have been computed. Except for a 200-h.p. plant at Husum, on White Salmon River, there are no developed powers on any of the above-named streams.

In presenting the power statistics the average minimum flow of the streams has been used. The average minimum may be defined as the mean discharge for the lowest week in each year, averaged for a succession of years, say ten. The absolute minimum in a ten-year cycle might be as low as a third or a fourth of the average minimum, but it would continue only for one or two days, possibly only for a few hours.

Summary of Results.

Klickitat river leads all others in this region in opportunities for water-power development. Seventy-three miles of the main river were surveyed with a range of 3255 feet elevation.. The river next in importance is the White Salmon, with a fall of 2660 feet in 32 miles. Lewis river was surveyed for 51 miles, in which distance a fall of 1495 feet was found. Toutle river is 54 miles long, the entire length being mapped. It has a fall of 3153 feet. Little White Salmon river is of secondary importance. The discharge is low, but the stream has a steep grade, a fall of 1285 feet being found in the 8 miles surveyed.

The following table gives a summary of the data obtained during the season of 1909 in this region. The total horsepower for the average minimum discharge of the streams as surveyed is 386,500.

SUMMARY OF WATER-POWER SURVEYS.

Stream system	Miles surveyed.	Total h.p. for average minimum discharge.
Klickitat	81.2	154,000
White Salmon	34.2	105,000
Little White Salmon	8.1	5,500
Lewis	65.0	78,000
Toutle	59.6	44,000
	248.1	386,500

It would probably be safe to add about 8000 h.p. for small tributaries and portions of the main streams not surveyed, giving in round numbers 395,000 horsepower for the streams named above. The principal streams not surveyed in this region are Wind River, Washugal River, Salmon River, South Fork of Lewis River, Kalama River, South Fork of Toutle River, and Green River. The aggregate power on these streams at low stage is probably not over 30,000 h. p., making a grand total for this entire area of 425,000 h.p.

It has been estimated from very meager data that the total water-power in the Columbia river basin will aggregate 10,500,000 horsepower at the average minimum stage of the rivers. The possible water-power development of the region under discussion, therefore, is only 4 per cent of this total. At present the water-power plants in operation in the State of Washington have an aggregate rated capacity of about 81,000 horsepower, so that the possible development in this region is five times that already developed in the State.

Conditions Governing Hydraulic Development.

From the standpoint of the public an answer to the question, "How much water-power is there on a certain stream or in a certain territory?" is of great importance. In areas where great water-powers are known to exist and public-service corporations are appropriating them as fast as or faster than a market for them grows, the interest of the public in their development becomes a paramount issue.

The long-distance transmission of electric energy has changed our perspective of this resource amazingly during the last ten years. A few years ago the use of water-power was limited to the immediate locality where it was developed. Now a hydroelectric plant can serve the industrial and community needs of an area 200 miles or more from it. This fact makes water-power a public utility. The natural laws that govern the development of hydroelectric powers and the social and industrial conditions that supply the market for them make consolidation and community of interest among those engaged in their operation inevitable. In the operation of power plants for public service it is of prime importance that continuity of service be assured. The natural conditions of stream flow make it almost impossible for a single plant depending on water-power alone to insure continuous service. Hence the necessity that one company should operate several plants.

The requirements of power consumers are by no means uniform. They vary from hour to hour, from day to day, and with the seasons. This non-uniform consumption requires that a certain reserve be maintained at all times to meet "peak loads" during the day and

for regular and extraordinary demands that arise from time to time. Hence even where one company operates several plants it is virtually required to maintain auxiliary steam plants to be used in connection with the water-power plants.

From the standpoint of the consumer also, whether an individual, a company, or a municipality, there is every advantage in having the sources of power under one administration. Efficiency in operation and economy in consumption therefore demand consolidation of interests. Such a consolidation, which makes for conservative and efficient use of the natural-power resources, should not be prevented. The public concern, therefore, must be aimed, not toward prevention of consolidation, but toward prevention of the harm to the public interest that might result from an unscrupulous administration of such a consolidation. The solution appears to lie in a wise legislative regulation of the manner in which power privileges shall be acquired and power plants maintained in order that the consumer shall be assured the necessary energy at a reasonable cost, consistent with a just and reasonable income on the investments by the power companies.

The factors that govern power development are three—(1) the volume of water available, (2) the fall through which this water can be utilized, (3) the market for the power when developed.

A project is feasible or not according as these factors are favorable. The market feature is, of course, independent of the other two and is subject to evolutionary laws. Therefore in a public inquiry such as that covered by this report it is necessary to consider only the physical features of discharge and fall, and to include all portions of a stream where such features make power development possible. Yet a consistent regard must be had for practicability of development, and some standard of comparison must be adopted.

In developing power plants it is profitable to install power units for a much larger amount of power than that represented by the minimum flow of the stream, for it is always necessary to have auxiliary steam plants which can be used to tide over a period of shortage of water and are called on for the peak loads. The interest, depreciation, and maintenance charges of a steam plant must be carried in conjunction with the fixed charges on the water-power plant. Hence the excess of power capacity which it is profitable to install over that afforded by the stream in extreme low water will depend on the relative cost of steam and water-power and on the peculiarities of the particular market served. This excess may vary from 50 to 300 per cent.

In presenting general power statistics it is impossible to estimate this excess, and all that can be done is to state the power for the average minimum discharge of the stream and the known fall. The theoretical power thus obtained is arbitrarily reduced 30 per cent to represent "brake" horsepower, or the power that could probably be delivered to the turbine shafts. Where special studies are made the figure so derived can be increased or reduced according to the exigencies of the case.

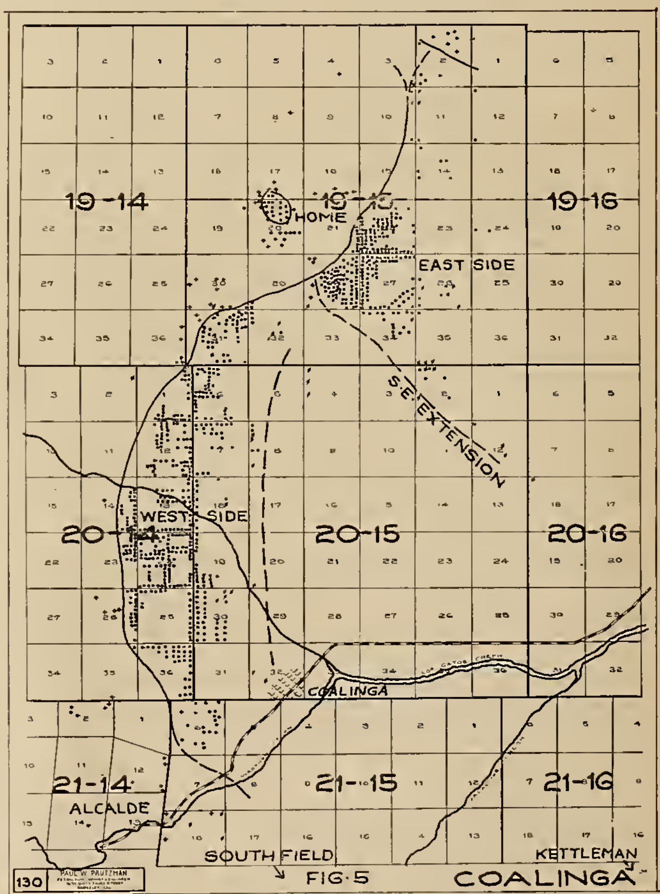
PROSPECTS FOR NEW PRODUCTION OF GAS MAKING OILS.

BY P. W. PRUTZMAN.

(Concluded)

Coalinga (See Map No. 5).

In this field we have two sub-districts, one entirely separate, the other two not yet joined, though work is proceeding in that direction. The little Home pool was long ago marked out by a complete ring of dry holes, and there are no prospects whatever for extensions, so far as the immediate neighborhood is concerned. Two rigs are at work back of the heavy oil territory, in hopes of finding extensions of the "Home Sand," and the deeper of these holes has reached a depth which should bring it close to this sand, if in place. No results are yet reported. Home oil is a green oil of 32 degrees gravity.



FIG·5 COALINGA

Any northern extension of the East Side field seems to be stopped sharply by several deep failures on Section 2. Whether an extension will be found to the northwest is problematical, though some work is being done in that direction. Between this limit and the main East Side field there is quite a strip of proven territory, but this is almost entirely in the hands of two large corporations, and does not cut much of a figure in immediate calculations. To the east no limit can yet be set, but wells in this direction are rapidly growing deeper, and even now are reaching the limit of profitable drilling. The same may be said of the work down the Coalinga anticline, or South East Extension. A large amount of excellent territory has been opened up by the work done in the last four or five

years, but drilling is so deep that development is necessarily slow.

In the main portion of the East Side field, two sections to the west are largely drilled up, and are sharply marked at their western side by the cropping of the formation. At least one very deep well failed to find a lower sand, and while there is considerable territory a little farther east yet waiting for development, I do not believe that considering all the conditions, more work will be done at present price of crude than will maintain production level. I look to see the production in this part of the field, taken as a whole, remain about stationary so long as present be had to the east of it until the apex of the Coalinga anticline is passed.

At the south end section 6 appears to be about the limit, though it is possible that parts of 7 and 8 are good—these are both tied up, and no work is being done. Work in the Alcalde group has resulted in entire failure, and nothing is to be expected in this direction unless it is found that the sands of section 6 extend back as far as 18.

Even the bounds set leave a large amount of undrilled territory, capable of heavy total production, but I do not believe that any particular increase of output at present prices is imminent. Most of the smaller

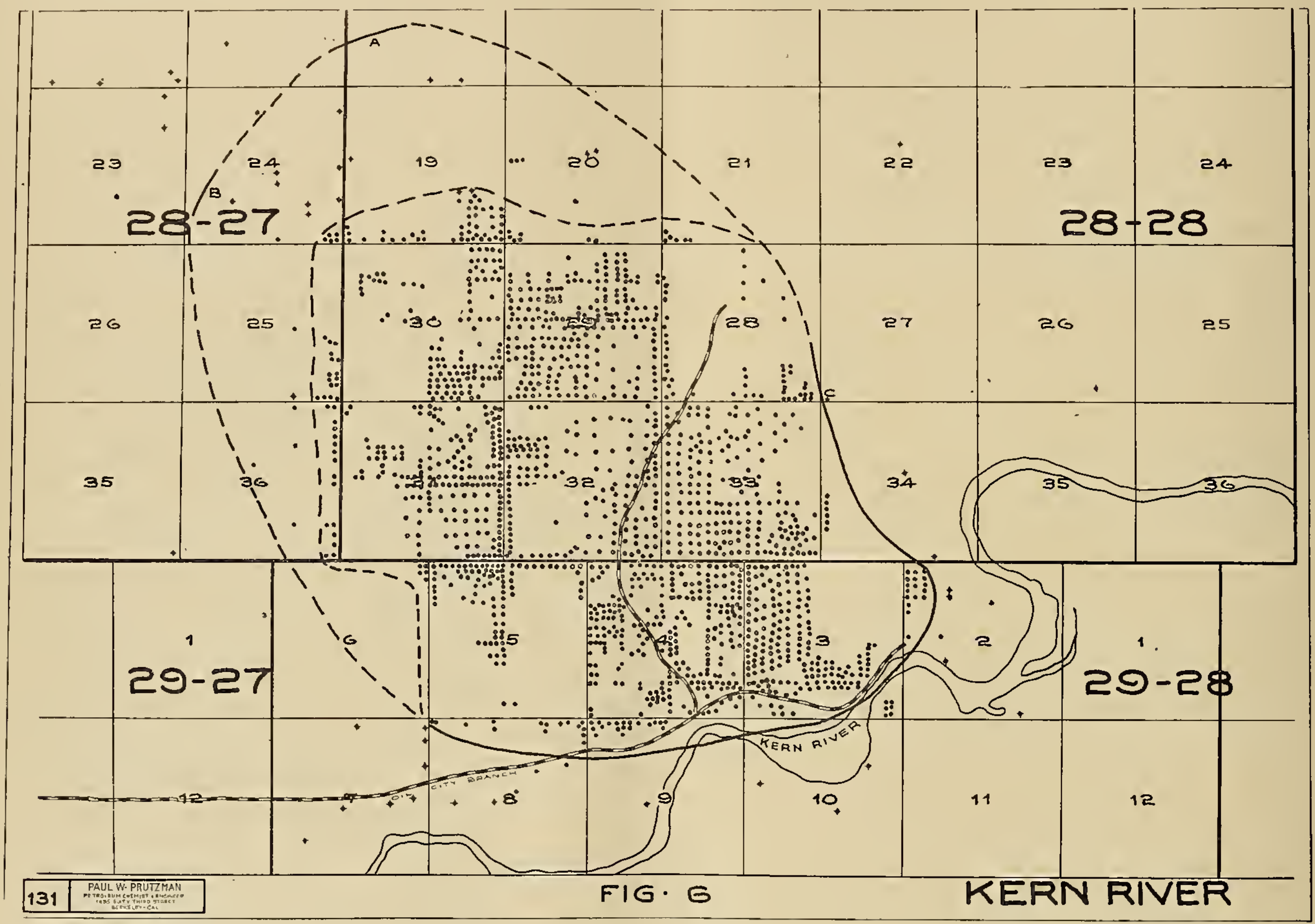


FIG. 6

market conditions continue, though it could undoubtedly be increased to meet a more active demand.

In the West Side field we have shallower wells, as a rule, and a much greater number of operators. This group is pretty plainly marked off at its western edge by the cropping of the formation, and so far the wells drilled in the older rocks farther back have not been successful. At the northeast there is still room for a small extension, if it should be found that the sands continue to be productive across 28 and 32-19-15. On the southeast, two wells on 20 and 32-20-15, though both had oil, do not seem to encourage work farther out, as both were quite deep and had quantities of water at the bottom. Further north, along the west line of Section 8, work done lately has been quite successful, but the ground east of this does not look promising, as a very deep hole on Section 4 has not shown up anything. I have marked in this limit as doubtful, but do not believe that much production will companies, who are the most likely to force production onto a falling market are along the back edge, where the new work has not been profitable, and where the possibilities of large production are limited. Most of the vacant territory to the east, where drilling is deeper and production larger, is in the hands of large operators who will certainly see their interest in holding production down to what the market can absorb.

One the whole, while Coalinga has undoubtedly large capacity for new production, which can be drawn on at any time, I do not believe that the production will be allowed to increase materially, if at all, while prices remain as at present.

South of the Coalinga field, some work is going on in Jacalitos and in the Kettleman Hills. One well in Jacalitos has reached a great depth, and is said to show very good indications, and in Kettleman the prospects are good for the opening up of some new territory. In either case, however, anything new will

be very deep, and development correspondingly slow, so that we have no reason to expect anything which would influence prices for some time to come.

Kern River (See Map No. 6).

On reference to this map you will notice two dotted lines, coalescing to a single solid line. The latter marks the lower limit of the field, beyond which production cannot extend, and plainly shown by a number of dry or valueless holes. Two of these were very deep, and failed to find a lower sand, and a well now drilling on the bluff south of the river does not indicate any prospects in this direction.

The inner dotted line, taken in connection with the solid line, bounds the positively proven area, and all parts of the area included are capable of what is called good production in this field, where wells are shallow and cheap. Within these limits there are still large vacant areas, which are probably capable of about as much production as any other parts of the field, though it is likely that near the edges wells cannot be spaced so closely as in the heart of the proven area.

Between the two dotted lines is a second area now giving some production in parts, and probably capable of producing more or less oil over most of its extent. Just how valuable this territory may be remains to be proven—only a small number of wells are now pumping, and operations here have met with some drawbacks.

Outside of the outer dotted lines any production of value seems doubtful. Certainly the field is limited to the east, at the point "C," and just beyond the points marked "A" and "B" are failures of sufficient depth to put a damper on any further work in this direction.

In spite of the enormous output from this field in the past, the wells have proven steady, and a comparatively small amount of new work has sufficed to maintain production. How long this will continue cannot be stated with certainty, but it is probable that no decrease is in sight for some time to come, unless it be a voluntary one. On the other hand, it is safe to say that there will be no sudden increase, as the production of individual new wells is quite small, a good deal of the territory in the heart of the field is in the hands of parties who develop slowly, and a great deal of new work would be required to bring about any increase which would effect the general situation.

McKittrick-Sunset Territory (See Map No. 7).

At McKittrick the west side of the field, and a good portion of the eastern margin, were long ago marked out by a line of dry holes, and attempts made lately to extend the main field to the east, resulted in entire failure. Dry holes limit also the north and south ends of the strip, and there do not seem to be any hopes of extension of already proven ground, nor of a connection with the Midway field.

Considerably east of the main field, a couple of rather shallow wells have lately developed some very heavy oil, about 12 degrees, but the production per well is small, and this territory is not generally considered very promising.

The little group southeast of the main field seems to have struck a sort of stray sand, and the production is small. These wells were drilled about ten years ago, and no attempt has ever been made to extend this group.

Though the area of the McKittrick field is small, the wells are as a whole productive and quite dependable. It is probable that the production of this field will remain about constant for some time, and then gradually decrease.

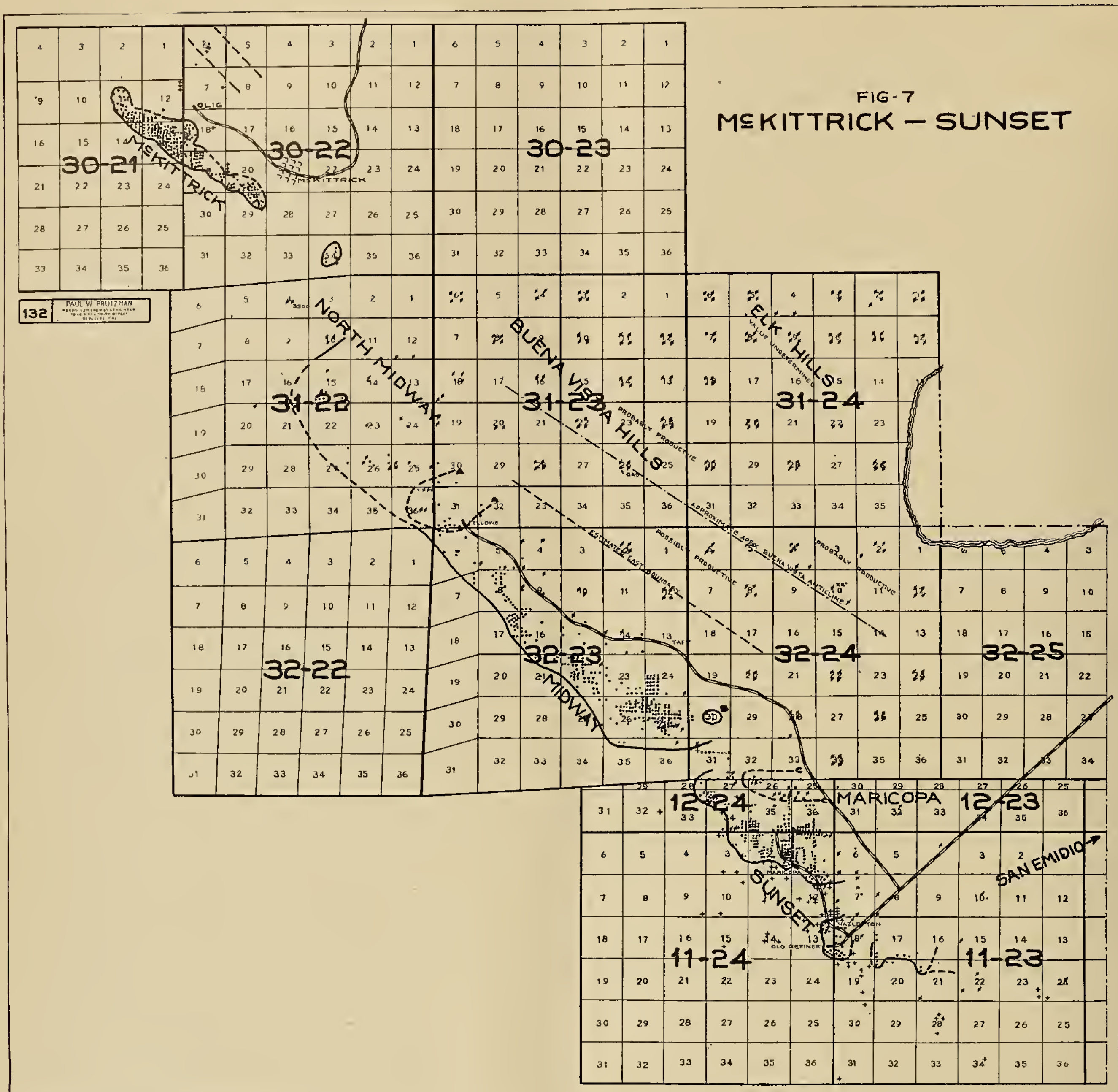
Now passing Midway, let us look for a moment at old Sunset field. The bulk of this field was developed years ago, and the limits to the southwest plainly marked by a large number of dry holes. Close to these limits the wells were, as a rule, shallow and quite productive, a hundred barrels a day from an 800 ft. well being not uncommon—this of an oil ranging from 11 to 14 degrees. On account of market conditions, most of these wells stood idle for a long time, but when put to producing rapidly dwindled to a small output. The reason seems to have been that, while the thickness of producing sand was not great, these wells produced from a coarse sand under a high gas pressure, which rapidly blew off when the wells were opened. Farther south, near Hazleton Station, a few wells developed lighter oil, in a finer sand with less gas, and while these wells were less productive initially, they are still making considerable oil, while many of the heavy oil wells spoken of have been pulled and abandoned.

Still farther south, near and to the east of the old refinery, are a number of pits and shallow wells, some of which have been producing for as much as twenty years, and are still profitable. These wells were always small producers, and had little or no gas.

The Sunset field is peculiar among the oil fields of California in being spotty. Even in Ventura, which is noted for the irregularity of its formations, the producing sands, while small, are usually of a definite lenticular form, or in some cases are limited by their steep inclination. But in Sunset the producing formation is folded and faulted in the most confusing manner. While less true of the western margin of the field, this is to some extent true of all the territory lying south of the north line of township 12, so far as drilling has been carried.

For instance, starting at the center of the west line of 1-11-24 and going north, we find the depths of wells to vary from 1100 to 3000 feet, and that not evenly but in such manner as to show three shallow spots, with two deeper troughs between. There is also a wide variation in the productiveness of these wells, which does not correspond with any recognizable position on the folds. This folded condition of the formation extends to the Lakeview well, or at least to the point where drilling has been carried, which is less than a quarter of a mile from that well.

Going east from the same starting point we find the depth of wells to grow regularly and slightly greater, with a considerable increase in productiveness, to the east line of section 1, where there is either a sharp fold or a fault. A well just over this line went 2000 feet or more to the tar sand, and has never produced, a second is considerably over 2000, with nothing but water, and a third had some oil but no pay at 2400 feet or over. This while the wells a short distance west of the line produced heavily at slightly over



one thousand, and on section 32, a mile to the northeast, a healthy producer has been brought in at about 1600 feet.

All this may be considered beside the point, but to my mind it has a direct bearing on the prospects of the southern part of the Midway field. And it would seem that, so far as any immediate results are concerned, the future production figures of the State rest largely on the behavior of this field. For when we have set aside Cat Canyon, Lompoc and Coalinga, we have left nothing but Midway which offers any promise of an immediate increase in production.

Midway appears to be limited to the north by two wells which, though still drilling, have reached a great depth without any result, and are probably failures. To the west it is marked by a scattering line of dry holes, and while this shallow territory has by no means been drilled up, the limits appear to be fixed, approximately at least. To the east no present bounds can be set, and prospecting is going on over an area many miles in width, but at present with but one producer far outside proven limits. To the south this field joins the Sunset field.

The wells toward the northern and western margins of the field are comparatively small producers, that is, running in the hundreds rather than thousands of barrels. On the average, however, they are steady, and in spite of the spectacular performances of several flowing wells, the bulk of the production of the field, up to the time of the Lakeview, had come from these smaller wells. The enormous output of the Lakeview, and very lately of a couple of adjoining wells, has of course put the regular production quite in the shade.

The big gushers in Midway have, to the present, been found in three groups, one (see A, Fig. 7), embracing the Santa Fe well on 6-32-23, the Eagle Creek, Crandall, American Oil Fields No. 56 and 79, California Midway, Mays and Pioneer Midway. The second (see B, Fig. 7), is the Standard's group of three

wells on 30-32-24, and the third (see C-C, Fig. 7), covers the Lakeview, Sunset Monarch, American Oil Fields on 32-32-24, and probably the Consolidated Midway on 30-12-23. The latter, and the Obispo well on 32-12-23 cannot yet be placed with certainty as regards their relation to other large producers.

The per diem production of some of these wells is so enormous that we are warranted in examining their history and relations quite closely, as if these wells should continue to produce at their present rates, and if the "gusher sands" should be found to continue to any great distance, the question of the disposal of the oil would become a serious one.

The wells of the first group are almost an unknown factor, as few of them have been brought to steady production. As is well known, they produce enormously for a time, then "bridge" or choke with sand and lay off for a considerable period, so that only one or two have had a chance to run their natural course.

The Santa Fe well was finished late in 1909. Its production was originally about 2000 bbls. a day of 21 degrees oil, and has fallen to some 400 bbls. at last reports. The "Crandall" well of the Hawaiian Oil Company was finished at about the same time and rate of flow, and has fallen off to a small production, through by some is considered to be choked with sand. The American wells are yet too new to give any information, and none of the other wells in this group have ever produced steadily enough to give any idea as to their probable life. And as no wells intermediate in position have been finished lately, we do not know whether the draining of the sands by such heavy production has or has not rendered impossible the bringing in of similar wells between those already drilled. However, from the data at hand I think we may safely say that the limits of this group will not be outside of those indicated on the map. And it must be borne in mind that not all the wells already drilled within these limits are gushers, by any manner of means.

As to the Standard's group of wells on section 30, it may be said that all these wells flowed, but only one was a phenomenal producer, and it is probable that this well is something of a freak, and does not represent the productiveness of any large area. This well was finished in December, 1909, and is said to have flowed for three months at an average rate of 8900 bbls. per day, has produced steadily, and is now down to 1200 bbls. or less.

The history of the Lakeview is well known. It was brought in during March, 1910, as a wild well, and has produced steadily ever since. At the start its output was about 35,000 bbls. a day, it reached its maximum about thirty days later when it did nearly 65,000, and is now down to 18,000 or 20,000. This decrease is plainly due to exhaustion of pressure, and not to any extraneous cause.

The nearest well to the west is a Sunset Monarch well, about one mile distant, which was lately brought in at a very large rate. Just to the north of this is a well of the American Oil Fields, also new, and said to be doing about 20,000 bbls. Neither of these wells has had a chance to show its durability.

It is evident that the gusher territory does not extend much farther in this direction, as about half a mile to the west and in the same line are four wells, which are considered to have reached the same sand, and which, while good wells, are not at all unusual. This gives us an approximate western boundary for this group.

To the north of the Lakeview no work has been done, and we have no certain information as to how far in this direction heavy production may extend. Probably not very far, if we may reason by analogy.

The dip of the producing formation is here almost northeast, but by some geological freak the territory south of the north line of Township 12 is, or at least from the drilling records appears to be, crossed by a succession of folds lying almost due east and west.

The three wells above mentioned lie in one of the troughs thus formed, and their comparative depths indicates a slight dip to the eastward. The depth of the Consolidated Midway well on 30 also corresponds closely with the angle thus calculated. South of this trough the formation rises, and on the ridge thus formed several shallower producers have been drilled. None of these wells have been satisfactory, as while they had heavy initial production, this rapidly blew off. South of this ridge another trough is indicated, then another ridge, and this folded or faulted condition of the formation (the drilling records do not show which) extends indefinitely toward the south and southeast. All the wells in this direction from the Lakeview show the same behavior, that is, a rapid decline from initial production, when this is large, and a considerable variation in the value of closely adjacent wells.

Now it seems to me rash to assume that the broken condition of the formation, as demonstrated south of the township line, suddenly ceases at the Lakeview, and that north of this point we will find a blanket formation, of equal value at all points. Indeed the drilling records farther north all indicate the contrary, for near the center of the northwest quarter of 31-32-24 is a well considerably over 3000 feet, which lines up with good production on both sides, and yet was dry or practically so. Many examples of this could be given. For these reasons I think we are safe in placing the extreme northern bounds of this gusher strip as shown on the map, and my own opinion is that the strip as finally drilled up will prove to be much narrower, if indeed there is a strip at all, and not merely a succession of rich spots, arranged in an approximately straight line.

To the eastward no bounds can yet be set to this gusher strip. The Consolidated Midway well is undoubtedly a heavy producer, though being under control it has not yet given any indications as to its probable life. Beyond this no work has been done which could have any connection with these wells, and the Obispo flowing well to the south is about 500 feet shallower, produces a different grade of oil, and appears to be on a separate fold, if not on a different formation.

We have now shown, so far as the data will warrant, an actually proven area, another and larger area prospected but not proven, and have indicated as

nearly as may be the spots where large "gusher" production is indicated (this should not be taken to mean that other such spots may not be found). Let us now summarize the actual prospects for production from these areas.

As to the territory lying east of the actually proven strip, but little is known. Only one well is actually producing in this entire area, and this not a large one, though the gravity of the oil is high. The fact that this producer is on the east face of the Buena Vista anticline, coupled with the fact that the Standard's well on Section 26, which appears to be on the apex of the anticline, is a gasser, would rather lead to the belief that a strip west of the apex, and extending to an indeterminate line down the valley between the Buena Vista Hills and the main ridge, will be gas territory or barren. Perhaps this is a large assumption on slender grounds, and for the present we will have to class this strip as possibly productive. The east flank of the Buena Vista anticline is practically certain to be productive, though to what extent it is yet too soon to judge. As to the Elk Hills, we know nothing at all, and prospecting here is based strictly on geological indications. A great deal of work is now under way, and the future of much of this work, which is being done on reserved government land, is shadowed by doubts as to the ultimate policy of the Land Office. Still, considering all the circumstances, it is doubtful whether the final decision in these cases can be other than favorable, to at least such operators as commenced work prior to the last withdrawal order.

Within the strictly proven limits of the main field we find a large area of undrilled land, which analogy with conditions at Sunset, and work already done, lead to believe will be more or less productive over its entire area.

Further, we may fairly expect at least some extension of the territory giving heavy producers, and even those now drilled may be counted for a very large total output before they fall to the pumping class. And indeed it is quite within the limits of possibility that other such areas will yet be discovered in virgin ground. So that eliminating any possibilities in Buena Vista or Elk Hills, or in San Emidio, we have still to reckon with a truly enormous possible prodution.

I say possible production because, except in rare cases, oil does not bring itself to the surface automatically, but is under the control of the operator. This brings up the next question, and one of interest alike to the producer and consumer—whether this possible production will be restrained so as to keep the actual output within market requirements, or if this be not done, whether it is possible to so control the output as to maintain a price materially above production cost, in the face of a continuous over-supply.

That there is a very large over production, not merely in sight but actually existing, can hardly be questioned, nor that this excessive supply is definitely in sight for some time to come. It is highly probable that the Midway field alone could, within a few months, be made to produce enough oil to supply our entire local market. Whether this production can be kept within safe bounds, I greatly doubt. In the case of Elk Hills and Buena Vista, this restraint will probably work automatically, once the discovery wells are finished, as the bulk of this territory is in the hands of large operators, who will undoubtedly see their interest in holding down their output, at least so long as the slightest chance remains of maintaining the market. Sunset does not appear at present to offer any great hopes, and prospects in San Emidio are uncertain, and far in the future at best. But as to the main field at Midway, such restraint is doubtful, as a large part of this field, and some of the richest parts, are in the hands either of weak companies, forced by their needs to sell their product for what it will bring, or else of those to whom a low selling price is an advantage. I do not see how it is possible, considering the large available production, and the hands in which much of it rests, to seriously restrict the actual output of this field so long as the production of individual companies can be sold at cost or above.

This brings us to the last question—can this overproduction, once bronght to the surface, be controlled so as to keep the selling price much above production cost. I must admit that I do not know. The problem is one of great difficulty, but is being met by the producers with well judged and executed plans, and with a rare degree of fidelity to the common cause. I can only give you the facts in the case, as I see them, leaving a decision as to the outcome to your own judgment.

Bavaria represents about one-tenth of the total population of Germany, and yet has at its disposal only one-two-hundredth part of the total output of coal in the Empire. Therefore it is easily understood that it is of considerable importance for Bavaria to find an equivalent for the coal with which nature has not enriched the country, by the utilization of the existing extensive water power. It contains about 2500 electric generating plants, of which 2/3 are privately owned, 1/6 belonging to the limited liability companies, and the remainder are owned by the Government, by communities, and by co-operative societies. Nearly half of the total power (128,536 kw., or 46.7 per cent) is supplied by steam engines without any other reserve power. By the sole use of water power less than one-tenth of the total produce is gained. Water and steam participate with three-tenths (80,724 kw., or 29.30 per cent).

POWER SITES WITHDRAWN.

During 1910 great activity has been shown by the U. S. Geological Survey in the withdrawal of lands recommended by the Survey in aid of proposed legislation touching the use and disposition of water-power sites, the total of such lands withdrawn during the year amounted to 1,219,818 acres, thousands of western power sites being affected. The total outstanding power site withdrawals at the close of the year were 1,454,499 acres. The water-power problem is admittedly one of the most important for which legislation is asked. While the Survey has made withdrawals intended to conserve the water-powers of the public domain, the Director's report sounds the significant note of warning that no power sites should be allowed to be acquired for speculation under another guise.

THE PHYSICAL MEANING OF ENTROPY EXPLAINED.

BY A. L. MENZIN.*

A careful reading of the criticisms and comments of Prof. Durand[1] and others on the physical meaning of entropy as advanced by me leads to but one conclusion—that I have not succeeded in explaining to others the simple physical significance of this term which my first article[2] attempted to point out. Only the mathematical significance of my definition seems to have been considered: the physical significance seems to have been overlooked entirely. Probably this is due to the fact that the consensus of opinion at the present time seems to be that entropy has no physical meaning—that it is nothing more than the name which Clausius gave to the expression $\int \frac{dQ}{T}$.

Since my first article attempts to point out what entropy really stands for in a physical sense, it seems necessary to re-develop the definition in the same way as it was developed originally, but with special emphasis on the physical significance of each step involved.

A clear understanding of thermodynamics, and of entropy, requires an appreciation of the fact that rejection of heat to an external substance, and therefore waste of heat, accompanies every practical attempt to obtain work from heat. In the gas engine and in the non-condensing and jet condensing steam engine the working substance is thrown away with the heat; in the steam engine employing a surface condenser only the heat is rejected, the working substance being retained for future use; in all heat motors heat is rejected in one way or another.

Carnot has shown that if a quantity of heat Q is absorbed by a working substance at a constant temperature T, and if the waste may be rejected at a constant temperature T_0, then the maximum work obtainable from the heat Q is $\frac{T - T_0}{T} Q$. The minimum waste is obviously $Q - Q \frac{T - T_0}{T} = Q \frac{T_0}{T}$

Now any conclusion based on the assumption that heat is absorbed at constant temperature would not necessarily be true when heat is absorbed at varying temperatures—a thermal condition characteristic of all working substances, particularly of the most common working substance of all—steam. In the process of making steam, the temperature of the feed water increases with the heat absorbed until steam temperature is reached, after which it remains constant during evaporation and then rises again during the period of superheating. Hence, in order that our definition of entropy may be broad enough to cover the actual working substances met with in practice, it should be based on the assumption that the temperature of the working substance varies during the whole or any part of the period of absorption.

Consider such a working substance, and the small amount of heat dQ (equal to an infinitesmal in the limit) which is absorbed at any instant, and therefore at a practically constant temperature T. According to the Carnot principle the minimum amount of this heat which must be rejected is $\frac{T_0}{T}$ dQ. If the unavoidable waste for each small amount of heat absorbed is $\frac{T_0}{T}$ dQ. then the total unavoidable waste L for the total heat absorbed is therefore the summation of all the small elements of waste. Employing the calculus and assuming that the temperature at rejection remains constant, we have

$$L = \int_0^Q \frac{T_0}{T} dQ = T_0 \int_0^Q \frac{dQ}{T} \text{ or } \frac{L}{T_0} = \int_0^Q \frac{dQ}{T}$$

Now $\int_0^Q \frac{dQ}{T}$ is what is known as "entropy," and the physical meaning of its equivalent is interpreted as follows:

In the conversion of heat into work, whether of heat external to a working substance or contained within it as intrinsic energy, entropy is the minimum unavoidable waste per degree of the absolute temperature at which all of this waste may be rejected by the working substance.

It should be observed that I have not said that entropy is the minimum unavoidable waste divided by the absolute temperature at rejection; but that entropy is the minimum unavoidable waste per degree of the absolute temperature at rejection. The question is—has "minimum unavoidable waste per degree of temperature at rejection" any physical meaning?

That unavoidable waste is a perfectly familiar physical entity cannot be denied. We are conscious of it through the sense of sight and the sense of feeling. For what purpose is a condenser if not to abstract unavoidable waste heat? Temperature is likewise a perfectly familiar physical entity; and, since we know that the amount of heat rejected by an engine varies in some way with the temperature at rejection, why is not "unavoidable waste per degree of temperature at rejection" a strikingly significant physical conception?

Consider the analogy between velocity and entropy. Velocity is the ratio of two physical entities—distance and time; entropy is the ratio of two physical entities—rejected heat and absolute temperature; velocity determines distance passed over, and is itself determined by the motive power which produces it; entropy determines unavoidable waste, and is itself determined by the law of heat absorption. The fact that the velocity of an automobile is determined by the size of the engine is not an obstacle to our thinking of the velocity as the distance passed over per unit of time; the fact that the law of heat absorption $\int \frac{dQ}{T}$ determines entropy should therefore not prevent us from thinking of entropy as unavoidable waste per degree of temperature at rejection. There are two aspects for any physical property—the cause and the effect. What we know of most physical properties is through the effect. It is the same with entropy..

A consideration of what has been said thus far

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[1] Journal of Electricity, Power and Gas, Dec. 3, 1910.
[2] Engineering News, Sept. 1, 1910.

might lead one to infer that this conception of entropy applies only to those limited cases where the state of the working substance passes through a complete cycle of change. A reference to the original article will disclose that this conception has a much wider application. In this article I have shown that in the process of obtaining work by degrading a substance from one thermal state to another, the minimum unavoidable waste per degree of temperature at rejection is the entropy of the heat required to restore the working substance to its initial state—this entropy, or relative waste, being independent of the path by which the substance attained its initial state and likewise independent of the path by which it attains its final state provided only that heat is rejected at some constant temperature. It is thus seen that the definition of entropy advanced is as applicable to the simplest of thermal changes as it is to the complex changes involved when work is done by a cyclical process.

Consider the numerical value of $\int \frac{dQ}{T}$. It is determined by the amount of heat absorbed, which tends to produce a thermal change of state; and by the temperature during absorption, which is determined by the inherent characteristics of the substance, and is a factor in determining change of state for the heat absorbed. Entropy is therefore a function of the change of thermal state of a substance and, hence, a property of matter. From what has been said thus far it follows that—**Entropy is that property of matter which determines the least amount of heat which must be rejected to an external substance during any change of thermal state.** It is numerically equal to the summation of the quotients of the elements of heat required to reverse the change of state divided by the respective temperatures during absorption, that is $\int_0^Q \frac{dQ}{T}$. In a physical sense it represents the least amount of heat which must be rejected for each and every degree of the absolute temperature at rejection.

Thus entropy, as a property of matter, is no more difficult to understand than velocity, specific heat, electrical capacity, electrical potential, and the numerous other physical conceptions concerning which there is no mystery. Assuming that the assumptions and mathematical processes employed in the development of this definition of entropy are valid, it is seen that there is no more "ghostliness" about entropy than there is about any of the other terms just enumerated. It is a simple conceivable property of matter which enables us to appreciate the possibility of obtaining work from heat.

To test our grasp of the physical significance of entropy let us consider a few problems.

A pound of air is heated at atmospheric pressure from 100 to 200 degrees Fahrenheit. What does the change of entropy signify?

It has been shown that change of unavoidable waste is associated with change of thermal state. An increase in the thermal state of a substance makes that substance liable to an additional increase in the amount of unavoidable waste—the relative increase is the "change of entropy." For the change of thermal state under consideration the change of entropy is

$$\int_0^Q \frac{dQ}{T} = \int_{T_1}^{T_2} C_p \frac{dT}{T} = C_p \log_e \frac{T_2}{T_1}$$

$$= .2375 \log_e \frac{200 + 459.5}{100 + 459.5} = .039 \text{ B. t. u.}$$

per degree Fahrenheit absolute, assuming that C_p, the specific heat at constant pressure, is constant, which is approximately true in practice. Thus an additional unavoidable waste of .039 B.t.u. per degree of absolute temperature at rejection is the result of heating the air to 200 degrees Fahrenheit. This must be incurred if the air is degraded back to its initial temperature, and will be the additional relative unavoidable waste if the air is degraded below this temperature, provided all waste is rejected at some constant temperature.

Problems of more practical interest are the following: What is the minimum steam consumption and the maximum thermodynamic efficiency of an engine operating on dry steam at 165 pounds absolute running non-condensing? What would be the theoretical saving by running condensing, assuming a vacuum in the cylinder of 25.85 inches? Feed water will be taken at 180 degrees Fahrenheit in the first case and at 120 degrees Fahrenheit in the second case.

It is not difficult to see that the most efficient way to utilize steam is by employing what is known as the Rankine cycle. In this cycle the working substance is initially water at exhaust temperature and pressure. The water is compressed to boiler pressure, heated to steam temperature, and evaporated into steam at this temperature. Adiabatic expansion then takes place until exhaust pressure is reached, after which the condenser abstracts the total heat of vaporization and returns the substance to its initial state as water at exhaust temperature and pressure. The work done is equal to the heat added minus the heat rejected. Since we must know the entropy to calculate the rejected heat, we must first develop the formula for the entropy of steam.

$$\text{Entropy} = \int_0^Q \frac{dQ}{T} = \int_0^{Q_1} \frac{dQ}{T} + \int_{Q_1}^{Q} \frac{dQ}{T_1}$$

$$= \int_0^{Q_1} \frac{dQ}{T} + \frac{Q - Q_1}{T_1} = \int_0^{Q_1} \frac{dQ}{T} + \frac{r}{T_1}$$

where r is the latent heat of vaporization, $\int_0^{Q_1} \frac{dQ}{T}$ is what is known as the "entropy of liquid" and $\frac{r}{T_1}$ as "entropy of vaporization." The values of these expressions for different steam pressures have been calculated and tabulated by Peabody and others and hence are readily available for the solution of problems.

In the Rankine cycle for the non-condensing steam engine, heat is employed to raise water from 212 degrees Fahrenheit to dry steam at 165 pounds absolute. The heat required per pound is 337.7+855.9—180.3, or 1013.3 B.t.u. The entropy is 0.5235+1 0370—0.3125, or 1.248 B.t.u. per degree Fahrenheit absolute. The absolute temperature at exhaust is 212+459.5, or 671.5 degrees Fahrenheit absolute.

By definition, entropy is minimum waste per degree of exhaust temperature. Hence, if the waste per degree is 1.248 B.t.u., the total waste for 671.5 degrees is 671.5×1.248, or 838.0 B.t.u. The work per pound is the difference between heat added and rejected, or 1013.3—838.0, or 175.3 B.t.u. Since one h.p. hour=2545 B.t.u., this corresponds to a minimum steam consumption of $\frac{2345}{175.3}$, or 14.5 lb. per h.p. hour.

For the condensing engine the working substance would be raised from water at 126.3 degrees to dry steam at 165 pounds absolute. The heat required is 337.7+855.9—94.3, or 1099.3 B.t.u. The entropy is 0.5235+1.0370—0.1756, or 1.3849 B.t.u. per degree Fahrenheit absolute. The absolute temperature at ex-

haust is 126.3+459.5, or 585.8 degrees Fahrenheit absolute. Since the entropy, or relative waste, is 1.3849 B.t.u. per degree, the total waste for 585.8 degrees is 585.8×1.3849, or 811.3 B.t.u. The total work per pound is, therefore, 1099.3—811.3, or 288.0 B.t.u.; and the maximum steam consumption is $\frac{2545}{288.0}$ or 8.8 lb. per i.h.p. hr.

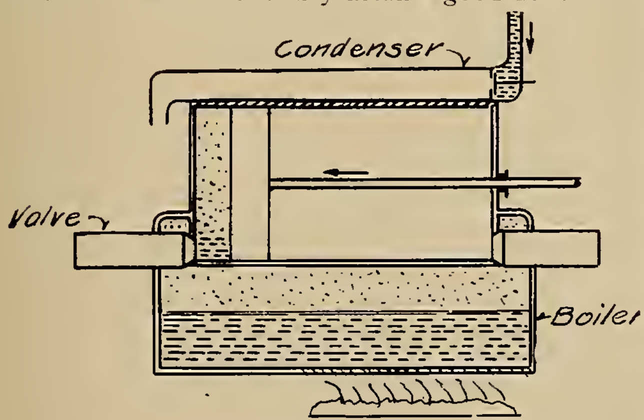
So far, the feed water temperatures have not been considered, since they affect only the heat (fuel) consumption and not the steam consumption. For the non-condensing engine with feed water available at 180 degrees Fahrenheit, the heat required is 337.7+855.9—148.0, or 1045.6 B.t.u. per lb. The work per pound according to the Rankine cycle is 175.3 B.t.u.; and the thermodynamic efficiency is $\frac{175.3}{1045.6}$ or 16.8 per cent.

In the case of the condensing steam engine, feed water is available at 120 degrees Fahrenheit, and the total heat required is therefore 337.7+855.9—88.0, or 1105.6 B.t.u. per pound. The maximum work per pound is 288.0 B.t.u. and the thermodynamic efficiency is $\frac{288.0}{1105.3}$ or 26.2 per cent.

The heat consumption per i.h.p. hour in the non-condensing engine is 14.5×1045.6, or 15,161 B.t.u. The heat consumption per i.h.p. hour for the condensing engine is 8.8×1105.6, or 9729 B.t.u. The theoretical saving by running condensing is therefore

$$\frac{15,161\text{-}9729}{15,161} \text{ or } 35.9 \text{ per cent.}$$

The practical man may remark: Assuming that all this is so, of what use are the results since they hold only for the perfect steam engine? To the engineer and the conservationist they mean a good deal.

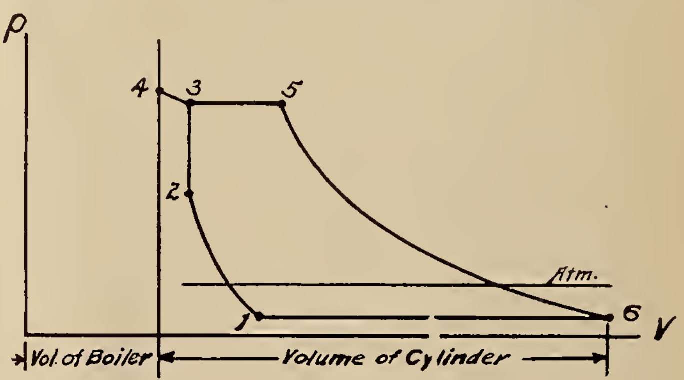


We have just seen that the perfect condensing steam engine operating under practical conditions has a thermodynamic efficiency of 26.2 per cent. Assuming a furnace efficiency of 70 per cent, the efficiency of the perfect engine in terms of the fuel consumption would be .70 x .262 or 18.3 per cent. A good compound condensing steam engine plant will produce an i.h.p. hr. on about 15 pounds of steam at its most economical load. Since the ideal steam consumption is only 8.8 pounds, this plant is utilizing only $\frac{8.8}{15}$ or 58.6 per cent of the theoretical efficiency. The plant efficiency is therefore .183-x .586 or only 10.7 per cent—a rather striking example of actual waste. Herbert Spencer has said, "Science is prevision." The conception of entropy enables us to appreciate the imperfection of our present day power plants with eyes wide open.

The student of theoretical thermodynamics may be interested in the accompanying sketch which shows a mechanical arrangement for a perfect steam engine and an indicator diagram supposedly taken therefrom. The diagram is the working cycle, and its efficiency is the ideal efficiency for the thermal changes involved.

Strictly speaking, a complete engine consists of a boiler, working cylinder, condenser, air pump and feed pump. The engine itself may do the work of the feed pump and air pump as in the accompanying sketch. This is accomplished in practice by driving the feed and air pumps from the engine shaft. Clearance space exists for mechanical reasons only and need not be considered in the perfect engine. Of course the engine is assumed to be made of material which is a non-absorber of heat, and the condensing surface is supposed to be a transmitter only when in use; hence there can be no cylinder condensation or conduction of heat except to the condenser. Owing to the location of the condenser only one end of the cylinder can be used at one time but this can be done by employing a heavy fly-wheel.

The operation is as follows: The initial position of the piston is as shown in the sketch, and is represented by 1 on the diagram. The condenser has just been cut out and the mixture of steam and vapor is about to be compressed. At point 2 the mixture has been compressed to water, and further compression compresses it to boiler pressure at 3 when the steam valve opens and the water is pushed into the boiler until the end of the stroke 4 is reached. The steam in the boiler expands and forces the piston back to the point 3, and from this point to the point 5 the water is heated to



and evaporated at steam temperature. At 5 the valve shuts. The weight of steam in the cylinder is exactly equal to the weight of water originally injected into the boiler and the steam in the boiler is at its initial quality and pressure. Adiabatic expansion then takes place to 6 when the condenser is put into service and abstracts heat at a constant pressure and temperature until the initial state 1 is reached when the condenser is cut out and the cycle is repeated over and over again.

For fixed steam and exhaust pressures the work done in this cycle may be varied by varying the compression, being greater or less according as the compression is greater or less. The heat required will be less as the compression is greater but, since it is more economical thermodynamically to use heat instead of work to raise temperature, the maximum thermodynamic efficiency will be obtained when there is no compression—in which case the cycle becomes identical with the Rankine cycle which has been employed in solving some of the above problems.

DISCUSSION OF PAPERS AT EIGHTEENTH ANNUAL CONVENTION PACIFIC COAST GAS ASSOCIATION.

The Oil Situation from the Gas Man's View Point.

Mr. Fitzsimmons: The paper just read covers the situation of the oil production in California very completely. However, aside from the production of oil in these oil fields today, that which should be most interesting to the members of the association is the production of natural gas, which was not mentioned in the paper read. There is now one well in the oil fields of California that is producing enough gas to supply the entire State of California. So that the possibilities of a large production of natural gas in this State are equally interesting to the members of this association as the production of oil. With the present equipment and facilities, of course, this gas could not be used for lighting purposes.

Mr. Collins: Gentlemen—This is one of the most alarming statements that has come before us since I have been at the convention. I would like to hear every word of it. Don't let it drop because all of us want to hear all about the situation. If an enormous quantity of natural gas is used in one location, it will probably shut down some of the great plants, and we want to know all of the facts. When a man goes into battle, he wants to know the power of his enemy. If we are going to combat it at all, we want to know all the features of it. I have heard some of it, and I want to hear it all, no matter how bad it is; I believe everyone within the hearing of my voice wants the information I desire. Therefore, will you kindly tell us these facts according to your own observation or experience? I would like to know them, so we can all have the benefit of them. We want to be prepared to meet the enemy or utilize it, whatever the case may be.

A Member: With regard to the gas well mentioned, there is but little that the gas men of the Pacific Coast need to fear. The Texas field was ruined, or practically ruined, by the presence of natural gas, yet there is, no doubt, a gas plant being erected almost each month in Texas, for the manufacture of artificial gas. The same is true of Louisiana, where there are also large fields. It has been stated that the gas produced in this well is not gas; it is vapor. It has considerable value as a heat generator if it could be utilized, but it could not be transported any great distance without a good deal of expense. Last, but not least, we must take into consideration the power of the great Owens river. The Owens river supplies lots of water for the city of Los Angeles, and in this regard we must not overlook our own interests. The fact is, that the greater the amount of water brought down, the greater the demand. A subject not to be forgotten is that expensive gas mains are required to conduct natural gas under high pressure, and it costs more, I think, than it would to conduct artificial gas under similar pressure. Different stoves are needed to utilize natural gas, and they cost more money. And don't forget that the men who bring natural gas from this wonderful well for you and me will not give it away; he is going to charge money for it. His development of the system will cost a tremendous amount of money. I think that the logical contention over all arguments of this character is to get busy and develop our plants to the highest state of efficiency.

Mr. Lowe: I heartily agree with the remarks of the last speaker, but nevertheless it is necessary for us, as gas men, to take cognizance of every existing condition. If there be 45,000,000 feet of combustible vapors going to waste in the Midway field, and it is to continue to flow 45,000,000 feet, or only one-tenth of that sum, someone is going to find a way to fix that vapor into gas and bring it into our large cities. We must be afraid; we must take cognizance of every existing condition, and there is no one in this world so greatly fooled as he who fools himself. If we have large fields of good natural gas, that is the product that we, as gas men, want. We have our distributing mains, we have our services, our meters, and we want that gas in them. We welcome the man who will deliver it, and if he cannot find the money, we will help find it for him.

Mr. Martin: I am a stockholder in an oil company that has a well in the Midway field. But there is no such pressure as they have. The pressure is 350 pounds to the square inch. There is not a holder there who wouldn't prefer to pump his oil and sell it, than burn it under his boiler, if he could get something for it.

Mr. Berkley: If our friend from Inglewood will look at what is being done in the Louisiana fields, he will see there is a pipe line 243 miles long reaching Little Rock, Arkansas, and distributing gas under high pressure. If the quantity of natural gas in the field, of which our friend has just given the figures, is anywheres near that, I assert that we ought to get in line. It is cheaper for us even at the present selling price, as much as we pride ourselves in manufacturing, and I would welcome natural gas under right and proper conditions. I know nothing of the field beyond what I have read of in the last three months. I believe it is a transportable gas in its present state, and will not require changes to be made so that it can be transported.

Several years ago the Indiana fields furnished a rock pressure of 450 pounds, and gas was transported to Indianapolis through a hundred miles, or more, of pipe. At that time the city had a population of nearly 200,000, and for a period of about twelve years hardly a carload of coal was sold for domestic purposes; there was not even a boiler from the street cars down that was not operated by natural gas. All of the large mills and foundries, such as the Indiana Car & Foundry Company, used natural gas. Therefore, I do not think there is any question about the right and proper consideration of this subject, and if there is such a quantity, and it is obtainable, it is up to us to get it.

Mr. Schade: I would like to ask Mr. Enger to give us his opinion. He has traveled extensively and is undoubtedly familiar with all the natural gas conditions of the country. I would like to ask him to give us his opinion.

Mr. Enger: My opinion, I am afraid, is rather a childish one. There is one aspect of that pipe to St. Louis, that is in regard to getting the franchise, and there is this: that they could make gas in St. Louis for less than they could get the natural gas. But my point which is rather childish is that in Kansas some time ago, there was a great discussion in regard to a well, which spouted how many million feet, but it got away from them, and after about six weeks they captured it again. I told some friends of mine that they were going to have an earthquake, and it happened that only a few days after that the earthquake at San Francisco occurred. My theory was this: You all are familiar with the air lock and know how they are applied to keep water out of natural gas, and it was on account of the pressure, and it was suggested that the State legislature of Kansas adopt measures to compel people to use natural gas to save their lives and property. This is just a theory but there is something in it. However, I think I might say that you could advance a great deal in the manufacture of gas in this section. There is a great deal more to be done. But I want to repeat something that I said yesterday. I didn't come here to speak, I came here to learn. I am not prepared to say much, but I have learned a great deal since coming here, and if it hadn't been for my friend Mr. Schade over there, I wouldn't have said anything about this earthquake. It is my theory and no joke at all. I say though, that you could improve your plants to make more from the oil than you do. It may be possible to make gas from oil for less money than it would be to pump natural gas and give it away.

Mr. Britton: I am impressed very much this morning by this discussion, because it takes me back a great many years, before a great many men in the gas business here were out of their swaddling clothes. Away back in the early part of '80 and the latter part of '70, the gas men of that day became very much agitated over the advent of electric lighting. Their doom in their own minds was assured. They thought they saw disaster staring them in the face. The board of directors met as usual, and with blanched faces awaited the blow which was to kill them. Their stocks and their bonds went down from above par,

to almost any price which anyone was willing to take them for. History is today repeating itself. The men who were fortunate enough to buy stocks and bonds of the gas companies that were depreciated, have made millions out of their investments. Now I don't want to see riot run here this morning, I don't want to see everybody become pessimists, merely because of the fact that a gas well has been discovered in Southern California, capable of producing enough gas to supply the entire State of California. I think we have merely to look over history, the history of the introduction of natural gas in Eastern States, in order to assure ourselves that we will be in the gas business long after the gas wells have died a natural death. The advent of natural gas in the Eastern States, and the advent of natural gas in California, has done nothing more than to increase the efficiency of the legitimate gas manufacturer. We have it around San Francisco Bay; it has been recently discovered in Sonoma County, and at Paloma, and it has not hurt the legitimate artificial gas industry in any way, nor can it. We also have it in Stockton, and Sacramento; not in limited quantities, but enough to supply the needs. It has been well said that the gas companies here today, with their present development and their plants and systems, are the natural distributers of that commodity, whether it be natural or artificial. The uses of natural gas are to a degree limited. It cannot possibly drive us out. The artificial gas companies, in the midst of the gas fields in this district have continued to increase their output, year by year. It would be impossible in my judgment and observation of the use of natural gas, to supplant the use of artificial gas entirely. It seems unlikely, that even if the amount of natural gas discovered here should be supplemented by other wells than those in the Midway field, it would never take the place of artificial gas, for the reason that every gas plant in use today, is constructed for the use of artificial gas, and would have to be changed and altered, to meet the conditions of the different character of gas that comes with natural gas. If they do come into the field, they will look, in my judgment, to the use of it in a way that the artificial gas companies have never been able to reach, and that is in larger industrial plants. They will consider the market for oil, and it seems to me that the people who control these fields are not going to cut off their nose to spite their face. These people have a tremendous output of oil, as evidenced by Mr. Burkhart's paper, and by their own admission, and the uses of natural gas, in competition with their own oil output must react upon their financial investment. They cannot throw one pet to take up another. There is more money in the oil business, and there is more money for the transportation companies than there would be in the transportation of natural gas. Now, we all know, at least those who are familiar with gas manufacturing, that the lowest or best cost to all of the companies in the manufacture and distribution of gas, is in its manufacture. The minimum part of the expense is there, The maximum part of the expense is in the distribution, organization, management, development and utilization of gas. The expense of delivering natural gas from fields four or five hundred miles away is obvious to you who know anything of the expense of its delivery to distant points. I am not afraid of the advent of this foe, so far as the legitimate development and manufacture of gas is concerned today, than twenty-eight or thirty years ago, did the advent of electric lighting. It will be but another prod in our side, to spur us on to the further development and utilization of the products that we have for sale. When you consider that in the United States today, that notwithstanding the combination of the companies interested in gas and electricity, that the gas sales have progressed equally with the sales of electricity, and that today, I have no doubt the testimony of the members will bear me out, that those engaged in the business of gas and electricity, that their gross annual revenues from gas equal, if not exceed, that of electricity, and better than that, in the plants which sell both gas and electricity, the profits arising from the sale and distribution of gas far exceed the profits derived from the generation and sale of electricity. I think that our Alma Mater is safe in our hands. I do not believe that the new born child coming in today can take our place, or drive us out of business. I don't want to see gas men become pessimists; I would rather see every gas man become an optimist on the question of the manufacture and distribution of artificial gas in the State of California.

NEW CATALOGUES.

Bulletin No. 129 from The Electric Storage Battery Co. describes the installation of a storage battery for the New River and Pocahontas Consolidated Coal Company. This is one of the few battery installations for this purpose, and the charts show the results that have been accomplished by the use of a battery.

Ad Book No. 22 just issued by the Westinghouse Electric & Manufacturing Company, contains a series of attractive advertisements suited to the use of central station companies that are anxious to boom Christmas trade in electrical appliances. Every "ad" in the book contains a reflection of the spirit of the Christmas season.

Bulletin No. 4782, just issued by the General Electric Company, entitled "Direct Current Exciter Panels," illustrates and describes exciter panels for use in connection with alternating current generator panels when for any reason separate control of the exciter is desired. The bulletin contains a complete description of these panels, also diagram of connections and dimensions.

"Type MW Slip Ring Induction Motors" is the title of Circular No. 1188, just issued by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. The circular describes a line of Westinghouse alternating current slip-ring motors designed especially for cranes, hoists and elevators. Reference is made also to suitable controlling devices and brakes.

The General Electric Company has just issued a booklet describing Miniature Decorative. Incandescent Lamps. The lamps are illustrated in color, and various designs representing fruits and flowers are shown. These lamps are used for decorating Christmas trees and also in connection with set pieces of artificial shrubs, trees, etc. The number of the booklet is B-3004.

The General Electric Company has recently issued pamphlet B-3006, which is a reprint of the paper read before the National Electric Light Association on the subject of "Street Illumination." This pamphlet compares the results obtained from the use of luminous and flame arcs with those resulting from the use of open and enclosed carbon arcs. The subject is treated from the standpoint of the illuminating engineer and is discussed in detail. The pamphlet contains half-tone illustrations showing street illumination by luminous arcs in various cities. There are also numerous diagrams. The subject is treated exhaustively and should be of great interest and assistance to all interested in this branch of engineering.

The Western Electric Company has just issued its Bulletin No. 5500, describing Hawthorn direct and alternating current enclosed arc lamps. The bulletin contains twenty pages and is well illustrated with many photographs, diagrams and tables. Separate pages are devoted to direct current multiple enclosed arc lamps, including the marine type, for 100 to 125 volt circuits; direct current multiple enclosed arc lamps, including the mill type, for 200 to 250 volt circuits; power circuit lamps, direct current enclosed arc lamps for power circuits, alternating current multiple enclosed arc lamps for circuits of 100 to 125 volts, 200 to 250 and 400 to 460; direct current series enclosed arc lamps for 6.6 ampere circuits, alternating current series enclosed arc lamps for 6.6 and 7.5 ampere circuits, Solaris arc lamps, both alternating current and direct current, and arc lamp accessories.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.
DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong
604 Mission Street, San Francisco

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Trees and Water

If the ancient Arabian nature-faker who perpetrated that poetic prevarication, "the tree is the mother of the fountain" were now living in some parts of our western country, where every drop of water is more precious than it ever was in the deserts of Arabia, he would soon find himself the most unpopular citizen in the township. If he could be shown that every lofty pine on the mountain top deprives an orange grove in the thirsty valley of needed sustenance, he needs must confess that he grossly exceeded the elastic limits of even poetic license. He mistook effect for cause. The tree may be the child of the fountain but never the mother.

From his mistake it is an easy transition to the universal misconception that forests always exert a beneficial influence on stream flow. So firmly is this false idea engrafted in the public mind that the engineer who substitutes fact for surmise and who proves that in many places the forests absorb much carefully conserved moisture is at once regarded as an enemy to mankind. We admit that these statements are startling and revolutionary, that they are contrary to all preconceived notions and upset many well-laid plans, but nevertheless they are facts. Careful observation has shown that on the Pacific Coast heavy forests are more often detrimental than beneficial to the even regulation of water flow.

More than two years have elapsed since Col. H. M. Chittenden presented a paper before the American Society of Civil Engineers, wherein he demonstrated that in the Cascade and Sierra Nevada Mountains forests prevent the formation of snow drifts and expose large snow surfaces to undue evaporation. Since that time the only refutation of his arguments is that they are not of general application and that in many special localities, particularly in Eastern states, the reverse appears true. In the resulting discussion many additional facts were presented to strengthen the original argument. Mr. W. H. Leffingwell and A. M. Strong, especially, showed that, whereas the drainage areas of the Merced and Kings Rivers were heavily timbered, these same rivers are subject to much greater fluctuation than the Kern and Owens Rivers which have little or no forest cover. It is demonstrated that entirely too much credit is assigned to the sponge action of the forest floor and that heavy brush is just as effective in retaining the greatest possible volume of water until such time as it is most needed for irrigation. It has also been established that the great expanse of ice and snow above the timber line is the reservoir supplying most of the water in the late summer months.

It was not the purpose of these engineers to discourage tree planting in the right places but only to make clear that the irrigation and power needs of the West are different from the navigation and power interests of the East. With thousands of square miles of arid land which needs but the magic touch of the water to become the most fertile in the world, it seems just that the demands of forestry should give way to the needs of agriculture.

PERSONALS.

R. J. Buck of Sanderson & Porter is in New York.

A. J. Turner, engineer for the San Dimas quarry at San Dimas, Cal., is visiting San Francisco.

F. N. Jewett, general sales manager of the Wagner Electric Company has returned to St. Louis via Los Angeles.

Rudolph W. Van Norden, consulting civil and electrical engineer, returned to San Francisco from Los Angeles this week.

A. A. Young of the von Hamm Young Co. of Honolulu is at San Francisco making his headquarters with T. F. Dredge in the Metropolis Bank Building.

W. S. Atkinson has resigned as chief draughtsman for C. C. Moore & Co., to take a similar position with the Yuba Construction Company at Marysville, Cal.

W. R. Wheaton, formerly with the U. S. Forestry Service, is in charge of the new pole creosoting plant of the San Joaquin Light & Power Company, at Fresno, Cal.

Henry Bosch, assistant engineer of electrical construction for the Pacific Gas & Electric Co., has recently returned from an extended tour of eastern power plants and factories.

L. B. Cramer, electrical engineer of the Oregon Electric Railway Company and chairman of the Portland Section, A. I. E. E., was recently appointed electrical engineer of the United Railroads Company of Portland.

J. C. Farrar, formerly electrical engineer with the Buick Motor Car Company at Flint, Mich., has opened offices as consulting, constructing and contracting engineer in the San Fernando Building, Los Angeles, Calif.

H. M. Fennemore, division commercial superintendent of the Rocky Mountain Bell Telephone Company recently visited Logan, Utah, and completed preparations for removing the billing and accounting department for the northern part of the State from that point to Ogden.

A. C. Sprout spent the past week on the San Joaquin River in connection with the installation of a reclamation pumping plant on the Webber Tract. Current will be taken from the Pacific Gas & Electric Company's transmission lines to operate a Westinghouse motor direct connected to a Samson centrifugal pump.

Wynn Meredith, Pacific Coast manager for Sanderson & Porter of New York, returned last week to his San Francisco office, after spending several months in the Pacific Northwest. Most of the time was spent on Vancouver Island in connection with the construction of the Jordan River hydroelectric plant of the British Columbia Railway, Light & Power Company, which will transmit current to Victoria, B. C.

Newly elected associate members of the American Institute of Electrical Engineers include L. W. Allison, draftsman, Pacific Light & Power Company, Los Angeles, Cal.; R. M. Cobb, construction foreman line department, Pacific Electric Railway, Los Angeles; G. E. Fairly, electrician, Los Angeles, Aqueduct, Saugus, Cal.; L. D. A. Gain, electrical designer and draughtsman, Western Canada Power Company, Vancouver, B. C.; R. E. Jerauld, commercial engineer, General Electric Co., Salt Lake City, Utah; C. B. Johnson, construction foreman, General Electric Co., San Francisco; V. R. Marshall, station superintendent, Central Colorado Power Company, Dillon, Colo; F. P. Mooney, Arrowhead Reservoir & Power Company, San Bernardino, Cal.; L. L. Newcomb, electrical operator Nevada-California Power Co., Bishop, Cal.; E. S. Pridham, engineer Poulsen Wireless T. & T. Co., Stanford University, Cal.; D. L. Schaaf, chief operator Bay Shore sub-station, Sierra & San Francisco Power Co., San Francisco; R. H. Spencer, constructing electrician, Southern California Edison Co., Los Angeles, Cal.

Charles E. Wiggin has resigned his position with John R. Cole & Company to become general manager of the electrical department of Dunham, Carrigan & Hayden of San Francisco. Mr. Wiggin has been actively associated with the electrical business in San Francisco for over twenty years during which time he has earned the friendship of all with whom he came in contact. For the fifteen years from 1889

Chas. E. Wiggin.

to 1904 he was with Will & Finck. In 1904 with the co-operation of John M. Kline and George Greenwood he organized the Electrical Contractors' Association and has served as its secretary ever since. During 1906 he was with the Western Electric Company and later went with John R. Cole Company. Because of his extensive acquaintances throughout the electrical fraternity and his thorough knowledge of local business conditions he enters upon his new duties under unusually favorable conditions.

MEETING NOTICES.

The Los Angeles Section of the American Institute of Electrical Engineers meets at Blanchard Hall, 231 South Broadway, at eight p. m. on December 29th. Prof. R. W. Sorensen of Throop Polytechnic Institute will give a paper "Transformers and their selections." All members of the electrical fraternity who may be in Los Angeles on that date are cordially invited to be present and join in the discussion.

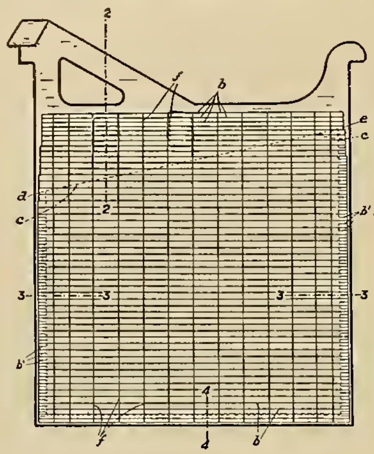
The Portland Section of the American Institute of Electrical Engineers met in the assembly hall of the Electric Building, on December 13, 1910. Mr. W. E. Evans of the electrical department of the Southern Pacific Company read a paper on the 1200 volt d.c. system of the Central California Traction Co. On January 17, 1911, E. J. Griffith will present a paper on Conservation of Natural Resources and on February 21, E. L. Ritter will speak on Telegraph and Telephone Work.

The San Francisco members of the American Society of Mechanical Engineers held a meeting in the assembly room of the Merchants' Exchange Building, on the evening of December 16th, for the purpose of discussing Pacific Coast Practice in the Use of Crude Petroleum for Fuel. Short discussions of the subject were read by Mr. Arthur F. Bell, Prof. J. N. LeConte, Mr. C. F. Weiland, Mr. C. R. Weymouth, Mr. K G. Dunn, Mr. J. H Hopps, Mr. A. M. Hunt and Mr. E. C. Jones, and the subject was discussed by many engineers present.

The Pelton Water Wheel Company has sold to the Utah Construction Company a 250 h.p. Pelton-Francis turbine which is to be direct connected to a Fort Wayne alternator and operated under an effective head of 80 feet. The plant will furnish current for electrically-driven hoists, air compressor and pumps at a mine in Idaho.

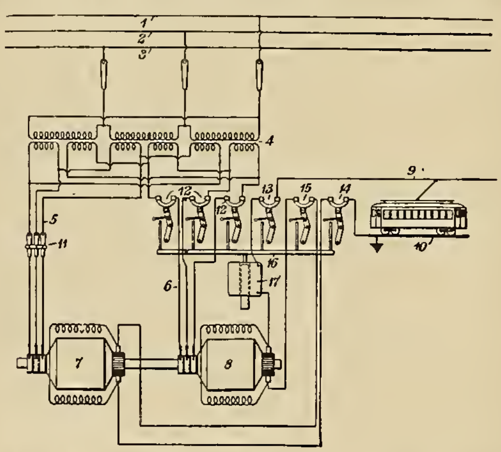
PATENTS

977,443. **Storage-Battery Plate.** Bruce Ford, Philadelphia, Pa. A storage battery plate consisting of groups of leaves united by ribs and having a marginal web, the ribs adjacent to web being spaced nearer together than the rest of the ribs



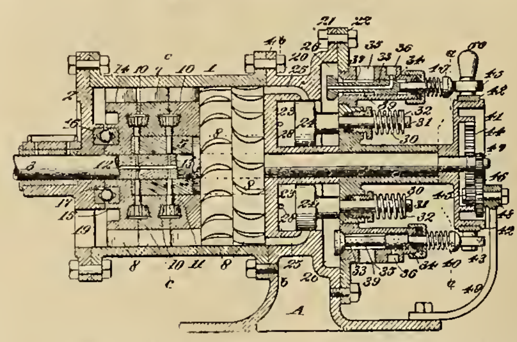
whereby the length of the span of the leaves which are attached to the web is decreased and the leaves are supported at closer intervals by the ribs to prevent their detachment from the web, substantially as described.

977,645. **System of Distribution.** Paul M. Lincoln, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. In a system of distribution, the combination with an alternating current circuit, a direct current circuit and two mechanically coupled rotary converters that are connected in



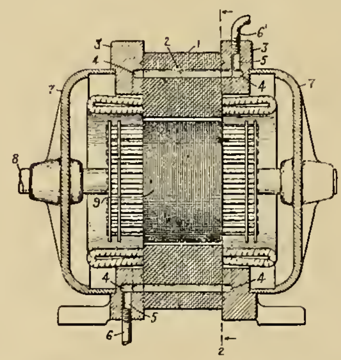
series relation to the direct current circuit and are independently connected to the alternating current circuit, of circuit breakers in the connections of one converter to the alternating current circuit, circuit breakers in the connections of the converters to the direct current circuit, and means for effecting simultaneous opening of all of the said circuit breakers.

978,044. **Turbine-Motor and Pressure Device.** Thomas J. Loftus, Castella, Cal., assignor of one-half to Charles T. Loftus, Castella, Cal., and one-half to Harmon Bell, Oakland, Cal. In a turbine motor, the combination of a turbine housing, a series of combustion chambers at one end thereof, means for delivering explosive fluid under pressure to said chambers, said means including air and gas inlets and normally closed valves controlling said inlets, means for operating the valves to permit the fluids to enter the explosion chamber, means for exploding said fluid in the chambers, said housing having passages connecting its interior with the explosion chambers, and horizontally slidable valves normally closing the inlet to said passages and actuated by the gases of the exploded charge to direct the exploded fluid to the



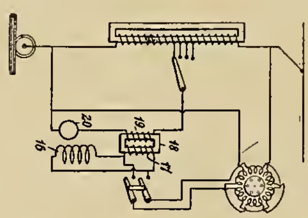
interior of the housing and to the turbine disks, a drive shaft adapted to be revolved by said disks, and connections between the shaft and the first named valves for operating the latter.

977,768. **Dynamo-Electric Machine.** John B. Wiard, Lynn, Mass., assignor to General Electric Company. In a dynamo electric machine, a stationary laminated core structure having a plurality of holes extending there-through for receiving a cooling fluid arranged in a circle, the interior walls of



said holes being coated or covered so that cooling fluid will not leak out between the laminations, and end frames clamping said core structure, each of said end frames having a circular groove registering with said holes and a channel connecting said groove to the exterior of said end frame.

978,038. **System of Regenerative Control for Electric Motors.** Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. The combination with a dynamo-electric machine adapted for operation either as a motor or as a generator and provided with

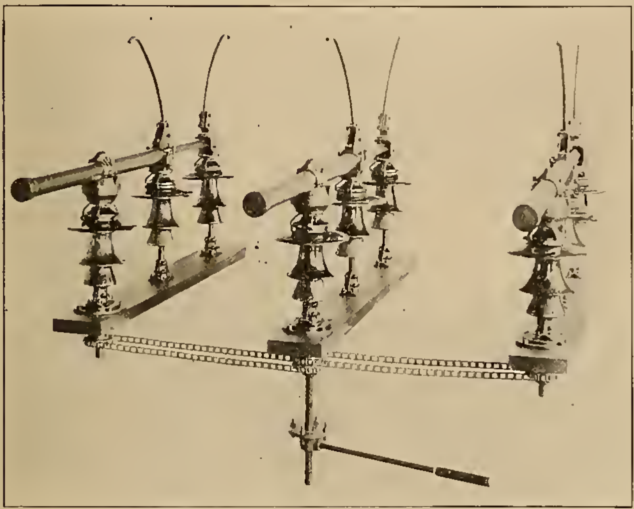


series-connected field magnet and armature windings, of a source of energy to be connected in shunt circuit to the field magnet winding when the machine is operated as a generator, the voltage of the source being approximately equal to the normal or predetermined drop of potential in the field magnet winding.

INDUSTRIAL

OUTDOOR DISCONNECTING SWITCH.

The accompanying illustration represents a photograph of one of a new line of outdoor disconnecting switches which the General Electric Company is prepared to furnish for use on circuits up to 110,000 volts. The entire line is high class in every particular, is thoroughly weather-proof and will act satisfactorily under all weather conditions. It should be particularly noted that this outdoor disconnecting switch does not in any way require special line construction, neither is it necessary to alter the spacing of the lines where they are connected to the switch since the contact blades in opening and closing move parallel to the direction of the transmission line.



Bolt Type, Outdoor Disconnecting Switch.

The illustration shows the switch closed. When the switch is opened all the blades move parallel to one another into the pipes. The blades are moved together by means of sprocket wheels and chains and a single operating handle which can be placed at any convenient point near the switch itself or close to the ground. The handle can be locked in the closed or open position.

The entire operating mechanism, including the sprocket and chains, is protected from the weather. The contacts are installed in housings and the switch cannot therefore be rendered inoperative by rain or snow.

The blades are so shaped that it is difficult for ice to form on them, but if this should happen, small wheels, which rest on the upper edge of the switch blades, serve to break this ice when the switch is opened, and thus keep it from getting into and clogging the mechanism of the switch.

The switch contacts are protected by goat horns, so that, in the event of opening magnetizing currents or larger currents accidentally, the contacts will be protected. That the switch is simple and substantial in construction can be readily seen from the illustration.

THE NEW WESCO CATALOGUE.

Catalog 150 of Electrical Supplies from The Wesco Supply Company of St. Louis is one of the most elaborate and comprehensive ever published. It contains 1324 pages, 8½ x11 inches and gives descriptions and prices of every conceivable kind of electrical apparatus. The illustrations and text are so detailed that it is really an encyclopedia of present day electrical practice. It begins with a thumb indexed sectional index and a general index of 21 pages. Many of the supplies listed are of Wesco make and the remainder are products of specializing manufacturers. This gigantic volume has been compiled by Mr. R. C. Mellor.

Apparatus described includes both large and small motors and generators, together with all accessory control, transforming and measuring equipment. To automobile ignition supplies 24 pages are devoted, 22 pages to electric heating devices, 14 pages to fans, 150 pages to fixtures and shades, 100 pages to house goods, including annunciators, batteries, bells, flashlights, medical batteries and speaking tubes, 20 pages to incandescent lamps, 22 pages to insulating materials, 60 pages to line construction materials, 22 pages to station supplies, 45 pages to street lighting supplies, 120 pages to street railway supplies, 65 pages to telephones and telegraph instruments, 55 pages to tools, 6 pages to electrical toys, 20 pages to wire and cable and 350 pages to wiring supplies. In all, there are over two thousand different kinds of apparatus and supplies listed.

In addition considerable general information and suggestions are given as well as a complete dictionary of phrases and code words, the code index alone occupying 115 pages. Many tables are included giving weights of all sorts of bolts, washers and screws. The metric units and their equivalents are given in detail as are also the standard electrical symbols and gauges. Electrical definitions and wiring computations of a practical nature are fully illustrated and explained.

TRADE NOTES.

H. T. Drennen will manage the electrical business of the firm of Davis & Drennen at 406 East Burnside street, Portland, as the firm was dissolved on November 1.

The Economy Electric Company has bought the electrical contracting business of Johnston and Sayre and will continue at 723 St. Helens avenue, Tacoma, Wash.

American Engineering Corporation has been organized with offices in the Mechanics' Institute Building, San Francisco, by C. E. Grunsky, L. W. Symmes, E. F. Haas, H. D. Connick, Loren E. Hunt, A. E. Chandler and Thos. H. Means to furnish specifications, reports, estimates, appraisals, superintendence, construction or operation in all branches of engineering.

Owing to greatly increased business the H. W. Johns-Manville Company announces the removal of its offices now located at 85 Sheldon street, Houghton, Mich., to more commodious and convenient quarters at 96 Sheldon street, where they will be better prepared to serve their patrons. As in the past, Mr. S. T. Harris, who has been associated with the Company for a number of years, will be in charge of the offices at the new address.

The Electric Storage Battery Company, through their Pacific Coast representatives, Pierson, Roeding & Co., are installing two large storage battery and synchronous motor generating sets to meet the hoisting requirements in Nevada mines. One order for 120 cells type G-35 "Chloride" accumulators and a 400 kw. synchronous motor generating set has been received from the Goldfield Consolidated Mining Company of Goldfield and the Tonopah Mining Company of Tonopah has also ordered 120 type G-31 "Chloride" accumulators to be supplied by a synchronous motor generator. These are in accord with the system of a. c. regulation which has recently been devised by the Electric Storage Battery Co. The Southern Pacific Co. has also ordered exciter battery sets for its new Fruitvale and Oakland sub-stations.

NEWS NOTES

INCORPORATIONS.

KERMAN, CAL.—The Kerman Telephone Company has been incorporated with a capital stock of $15,000.

VALE, ORE.—Articles have been filed for the Farmers' Electric Railway Company with a capital of $50,000, to construct a 25-mile S. W. line from this place. R. H. Dearmont and C. W. Thomas are among the incorporators.

FINANCIAL.

ASHLAND, ORE.—The City Council has decided to call a special election for the purpose of submitting a bonding proposition to the amount of $170,000 on the waterworks extension project.

ESCONDIDO, CAL.—The directors of the Mutual Water Company have levied an assessment of 5 per cent upon the capital stock for further permanent improvements to the upper end of the water system. The assessment will raise $11,000.

SIERRA MADRE, CAL.—The City Council passed an ordinance calling a special election to be held here to submit to the voters the proposition of issuing bonds in the sum of $40,000 to construct a municipal water system in this city. The bonds will bear 5 per cent interest, payable semi-annually.

VICTORIA, B. C.—At the forthcoming civic elections, among other many laws to be submitted will be one to authorize the raising of $25,000 for the purchase of electrical equipment for the extension and improvement of the street lighting system rendered necessary by the rapid growth of the city.

OAKLAND, CAL.—The shareholders of the Oakland Traction Company will vote December 31 upon creating a new bonded debt to the amount of $250,000 for the purpose of purchasing rolling stock. Said bonds are to be additional to the $12,000,000 bonds issued and issuable under the general mortgage of 1907. The directors include: E. A. Heron, Dennis Searles, C. P. Murdock, S. J. Taylor, F. C. Havens, Geo. E. Pratt and Arnold E. Needham.

ILLUMINATION.

JACKSON, CAL.—John L. Henry has applied for a franchise to erect electric lines for all purposes in the county of Amador.

TOLEDO, WASH.—The Toledo City Council has passed an ordinance granting to E. P. Badger and A. R. Badger a franchise for lighting the town of Toledo with electricity.

LA GRANDE, ORE.—J. L. Lambirth, one of the best known electric and gas men in the Northwest, is in this city for the purpose of asking for a franchise to install a gas plant here.

LONG BEACH, CAL.—Secretary George H. Marshall of the Long Beach Consolidated Gas Company, has denied the report that $300,000 worth of bonds of the $1,000,000 bond issue provided for by the company would be sold at once for expenditure in building the proposed new plant here.

STAYTON, ORE.—A. L. Shrevo, proprietor of the Stayton Electric Light plant, states that he has just completed a deal for the purchase of a power site three miles up the Santian river from Stayton. The site is a valuable one and capable of generating about 5000 horsepower. Modern power houses will be built on the site, which is located on the north side of the river.

PORTERVILLE, CAL.—At a meeting last week of the local stockholders of the Home Gas Company at the office of Geo. G. Murry it was definitely decided to organize an entirely new corporation to be known as the Porterville Gas Company, the object being to take over the interests of T. J. Wright, who is the Los Angeles capitalist at the present in control of the corporation. F. H. Hess, the manager of the company and the secretary of the corporation will immediately take up the sale of the stock.

TRANSMISSION.

EUGENE, ORE.—The Oregon Power Company, will expend $1,000,000 on a large hydroelectric plant on the McKenzie river near St. Martin's rapids.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company is planning the construction of a hydraulic power plant on the Grande Ronde river of 10,000 h.p.

ASOTIN, WASH.—J. J. Jennings of the Lewiston-Clarkston Company is here looking for locations for power lines to conduct 150 h. p. to a pumping plant to be installed across the river.

MURRAY, IDAHO.—It is reported that the Thompson Falls Water Power Company is surveying a right of way from Thompson to Murray and Burke, and will stretch wires as soon as possible to furnish electric power to Idaho mines.

LONG BEACH, CAL.—The big contract for the erection of a reinforced concrete, brick, stone and steel building for the Edison Company's power plant on inner harbor has been let to the F. O. Engstrom Company of Los Angeles. The building is to be completed before February 1.

KENNEWICK, WASH.—The R. E. Downie Pole Company, 432 New York Building, Seattle, has been awarded a contract by the Pacific Power & Light Company, Portland, for the supplying of the transmission poles for the construction of a high power tension line from this city to Hanford, Wash.

PLACERVILLE, CAL.—Henry Lahiff has filed notice of location of 5000 inches of the water flowing in the south fork of the American river in township 11 north, range 16 east, and also 4000 inches of water in the south fork of the American river in township 11 north, range 155 east, said locations being for manufacturing and electric power purposes.

AMERICAN FALLS, IDAHO.—Thirty thousand additional horse-power is to be developed at American Falls during the coming year by the building of a new power station, which will constitute the main plant of the system as projected several years ago. Authority for the announcement comes from Governor Brady who controls all the stock of the Idaho Consolidated Power Company.

PAYETTE, IDAHO.—The Telluride Association states that within two months it will construct a plant near the confluence of the Malas and Snake rivers. The plant is to cost $2,000,000 and will generate 10,000 horsepower. J. J. Nunn, manager of the Gale Light Plant in La Grand, Ore., has been awarded the contract for constructing the plant which is to be completed by March 1, 1911.

LOS ANGELES, CAL.—Captain John Cross, railroad builder, has filed an action against the Vallejo, Benicia and Napa Valley Railway Company, W. F. Botsford, Arthur F. Hawse, John T. York, L. J. Perry, Z. T. Hatch, C. M. Hatch

and other individuals and banking concerns. He demands that $15,000 stocks and bonds of the Vallejo, Benicia and Napa Valley Company be returned to him, or judgment for their value be given.

REDDING, CAL.—The Commissioner of the General Land Office had decided the case of the Northern California Power Company against H. V. Gates, upholding the decision of the local land office officials which was against Gates. Gates sought a patent to a building-stone claim in the Big Bend of the Pit river, which is particularly valuable as a power-house site. He had located 20,000 inches of water and proposed digging a tunnel five miles long to get the necessary fall for the project. The decision is important, as 18 similar cases are pending in the Redding land office.

TRANSPORTATION.

SAUSALITO, CAL.—The Northwestern Pacific Railway Company is in the market for a 2000 kw. d.c. railway generator set for its Alto power station.

PHOENIX, ARIZ.—The Glendale electric line will be constructed as soon as all the rights of way have been secured by S. M. Mitchell, superintendent of road.

LOS ANGELES, CAL.—Construction work on the Los Angeles-Pacific's new line from Hollywood to Lankershim will begin as soon as contractors can get their equipment on the ground. The contract, amounting to $250,000 has been let.

FRESNO, CAL.—The further investment of $100,000 in the building of interurban lines in the country is announced, with the statement from F. S. Granger, of the Fresno-Hanford Interurban electric line, that $100,000 would be employed in the erection of a power-house for his road to be built a little north of Fowler, ten miles southeast of Fresno. Ground is to be broken in a short time on Granger's line, running south from Fresno by way of Fowler to Hanford, to tap the rich Kings river bottom country, in which also two steam lines are now competing for rights of way.

TELEPHONE AND TELEGRAPH.

SALMON CITY, IDAHO.—The Lemhi Telephone Company has been granted a franchise to put in a telephone system here.

ABERDEEN, WASH.—The construction of the telephone line from this place to Westport has started. It is financed by E. C. Finch.

NORTH YAKIMA, WASH.—Wm. J. Smith, district commercial agent of the Pacific Telephone & Telegraph Company, announces that a branch telephone service will be established here and other extensions and improvements will be made this winter.

NEVADA CITY, CAL.—Nevada City will have an opposition telephone service during the coming year, as it is stated that the Home Telephone Company is investigating the field. Some of the Nevada City merchants who have interests in Grass Valley, are planing the building of a private line between the two towns.

SAN JOSE, CAL.—The Pacific Telephone & Telegraph Company has instituted a new service between San Jose and San Francisco. The San Francisco telephone numbers are now given to San Jose subscribers by the local operators, which does away with the necessity of giving the numbers desired to long distance. Under the new system it is possible for a San Jose subscriber to talk to a San Francisco subscriber by simply asking for the San Francisco number. It is the system now in use between San Francisco and Oakland.

WATERWORKS.

GLENDALE, ORE.—The Glendale City Council will in the near future meet to discuss the bonding of the city in order to improve and enlarge the waterworks system.

PETALUMA, CAL.—Fire Chief Wm. Zartman in his monthly report to the board requests that the board consider the advisability of installing larger valves in the hydrants.

SAN LUIS OBISPO, CAL.—The Board of Trustees has accepted the proposition made by Frank Tate, who owns lands and rights needed by the city for a greater water system and will proceed at once with the work of building a new reservoir.

VICTORIA, B. C.—Bids addressed to R. Fowler, municipal engineer, law chambers, Bastion street, Victoria, B. C., will be received up to the 27th of December, for supplying British castiron water pipe and special castings. Tenders must conform with the terms of specifications.

VALLEJO, CAL.—Mayor J. F. Chappell, Commissioner of Public Works Blake, City Trustee Butler and City Clerk Tormey are all convinced that 1000 feet of 6-inch pipe will be sufficient to carry half of the water needed by the city. The city already has 600 feet of the required pipe.

NORTH YAKIMA, WASH.—A preliminary survey is being made by the Pacific Power & Light Company for extension to the city water main, which after the change, will take the water from the Naches river six or eight miles farther up than at present and will result in a more constant water pressure through the summer months.

MARTINEZ, Cal.—The Port Costa Water Works has remodeled and doubled the capacity of its plant in the past six months, laying about 5 miles of 18 in. delivering main from near Concord to Martinez, increasing its well supply, building a new pumping station with electrically operated pumps, the power being derived from the Great Western Power Company, and making many other improvements to increase service, all done under the direction of M. M. O'Shaughnessy, consulting engineer for the company.

MERCED, CAL.—A new concrete diverting dam has been built by the Crocker Huffman Land & Water Company across the Merced River. This dam is 700 ft. long with concrete abutments 14 ft. high, and contains about 7000 cubic yards of concrete. It was built and completed in the record time of four months from the date of commencement, which was about the 20th of August this year. It has 500 feet of steel collapsible gates in the center, which can lower the level of the water 4 feet, thus passing floods without swamping the country above. It was designed by M. M. O'Shaughnessy, consulting engineer, and built by the Pacific Construction Company. George Schussler was resident engineer.

OAKLAND, CAL.—That work would be commenced at once on the pipe distribution system of the Bay Ciites Water Company in the city limits of San Leandro, was the announcement made at the meeting of the City Council of San Leandro last week. Col. M. M. Ogden of the Bay Cities Water Company states that the work would be rushed forward as rapidly as possible and that the company will be supplying water to its customers in San Leandro and East Oakland early in the coming spring. The new water company has also filed a bond for $5000 with the Board of Public Works of the city of Oakland to cover any damage that may result from excavating in the streets in laying the new pipe system. The company has already received 100,000 feet of cast-iron pipe, and over 200 carloads of pipe of various sizes from 4 to 12 inches will be here in ten days, and rushed out to sidings at Elmhurst, Fitchburg and San Leandro.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 26 | SAN FRANCISCO, DECEMBER 24, 1910 | PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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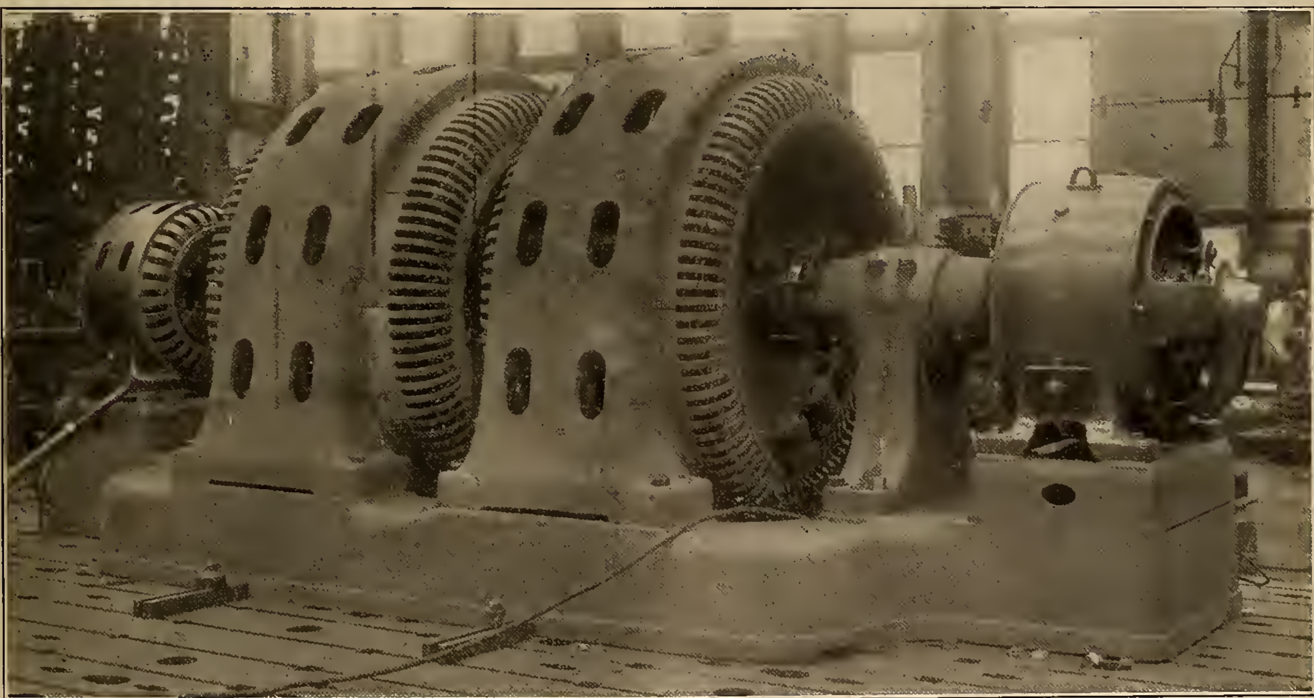
VOLUME XXV — SAN FRANCISCO, DECEMBER 24, 1910 — NUMBER 26

STARTING INDUCTION MOTORS

BY G. A. SCHNEIDER.

At a recent meeting of the San Francisco Section of the American Institute of Electrical Engineers a paper entitled "The Induction Generator," by Mr. F. G. Baum, was presented. This paper explained by means of numerous graphical diagrams and curves the action of the induction machine in its ordinary function as a motor, and the corresponding action as a generator. The discussion following was interesting, although brief.

The discussion recalled to the writer's mind another interesting question in reference to starting induction machines, not, however, as generators, but in the ordinary use as a motor. The question is one of determining the correct connections for a given direction of rotation. In numerous sub-stations motor-generator sets consisting of induction motors driving direct current generators are used. Sets of this kind are commonly started from the direct current side,



1500-h.p. 25-cycle Induction Motor driving 1000-kw. 60-cycle Generator. Starting Motor at the left—Exciter at the right.

In the writer's opinion, those present were mostly interested in the manner of starting an induction generator. It was shown that when first connected to the system the induction generator takes a heavy rush of current for the first few cycles of operation, the amount of this current depending upon whether the machine is connected when above or below synchronism, and to a certain extent upon the characteristics of the machine. This first rush of current may be limited by suitable reactive coils connected in the generator leads and short-circuited after starting,

especially in large distributing systems, the generator during starting operating as a motor. After the set has been brought up to approximately normal speed the line switch of the motor is closed. Should the motor leads not be connected to produce the same direction of rotation as that of the set at starting, the result would be a considerable strain upon the motor windings, shaft and other parts, or a disturbance upon the supply system. In connection with sets having a separate starting motor in addition to the regular driving motor, it it necessary to determine if direction of

rotation in both motors will be alike. When started for the first time, it is frequently convenient and in some cases necessary to know the direction of rotation for the motor of the set.

Most readers are familiar with the method of "phasing out" synchronous motors similarly used, as this subject has been fully covered by numerous publications, but do not so readily understand the test for induction motors. This is probably due to the fact that a synchronous motor is an active element on the system; that is, produces its own individual electromotive force when driven by another source, and with its field properly excited, while the induction motor (as will be shown later) will not have an electromotive force at its terminals until at least one set of windings is connected to the supply mains.

A method of making the required rotation tests for induction motors which should interest those doing construction work is outlined in the following paragraphs.

The principle of this test depends upon the action of a polyphase induction motor as a phase converter. The theory of a motor so used will be discussed briefly for the benefit of those who are not informed on this subject.

Transformation from one polyphase system to another is readily effected in an efficient manner by stationary transformers, but a single phase cannot be changed into a polyphase system with such simple apparatus.

The flow of energy in a single phase system is pulsating and in a polyphase system steady; thus, conversion from the former to the latter requires apparatus capable of storing energy during the period that the single phase input is greater than the polyphase output, and returning this stored energy into the polyphase system during the time the single phase input is less than the polyphase output. Both synchronous and induction motors meet these requirements, since by means of their revolving magnetic fields they supply currents and electromotive forces displaced in phase from those of the supply system, and can further store energy in the revolving elements. Machines used in this manner are known as phase converters. In this article only the induction motor used in this manner will be considered.

The paper heretofore mentioned shows plainly that the induction machine can operate either as a motor running below synchronism or as a generator above synchronism.

The motor and generator action may also occur simultaneously in one machine; part of the primary windings acting as motor circuits and others as generator circuits. Hence, if a polyphase motor is run single phase, electromotive forces will be induced in the idle windings. These electromotive forces will be displaced in phase depending upon the angular displacement of the idle windings from the primary phase.

Thus, a two-phase motor operated single phase will have electromotive forces induced in the idle winding which are approximately 90 degrees displaced from those in the active winding, and which when combined with the single phase supply circuit will give a two-phase system; or briefly stated, the motor will give two-phase current at its terminals. Likewise, a three-phase motor similarly operated will give three-phase current at its terminals.

The induction motor as a phase converter represents an instance of double transformation, the energy being first transformed from the primary or motor circuit to the secondary or rotor, and from the secondary to the other primary windings or generator circuits, which are also known as the tertiary windings.

Due to the internal losses in the machine and the magnetic leakage at the air gap, there is a considerable

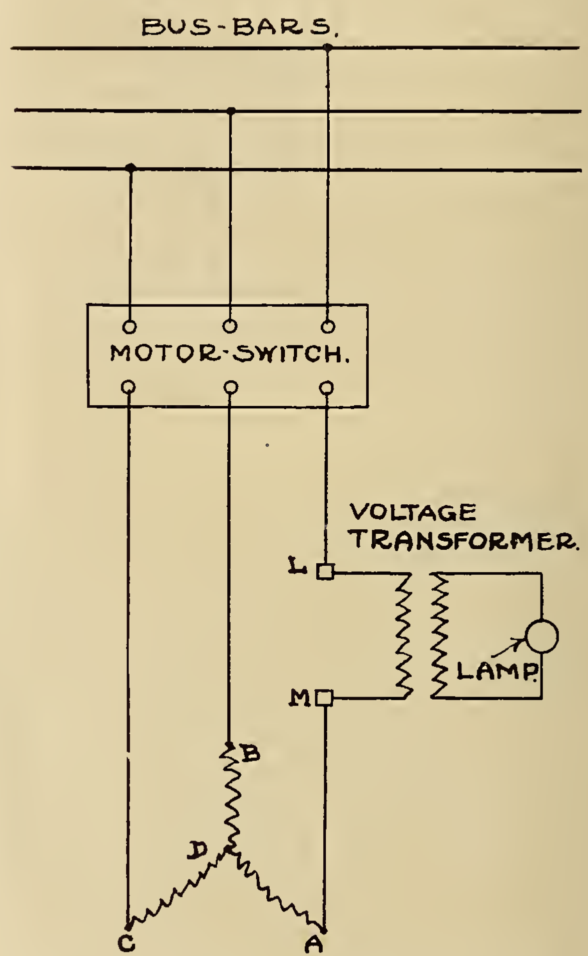


Fig. 1. Connections for Test of Three-Phase Machine.

loss of voltage during transformation and the resulting polyphase system is unsymmetrical. The voltage of the tertiary circuit with the machine running light—that is, with no load on the polyphase system or idle windings—is approximately equal to the primary voltage, but falls off rapidly with increasing polyphase output.

As the test is made with the motor running light the difference in voltage between the active and idle windings will not be sufficient to affect the results.

The method of conducting this test will now be explained, taking as an example the frequency changing set illustrated on the first page. This set is provided with a high torque starting motor having a wound rotor. The main driving motor is represented diagramatically in Fig. 1, which shows the connections for test.

First the set is brought up to approximately normal speed by the starting motor; then with the terminals of one phase open as at L-M, the main motor switch is closed. The motor will then run as a single-phase machine from the leads C-B; at the same time an electromotive force, practically equal to that of the active winding, will be induced in the idle winding between D and A.

Now if the direction of rotation is to remain unchanged with all phases connected (motor running polyphase) the instantaneous polarity of the points L and M must be such that there will be no difference

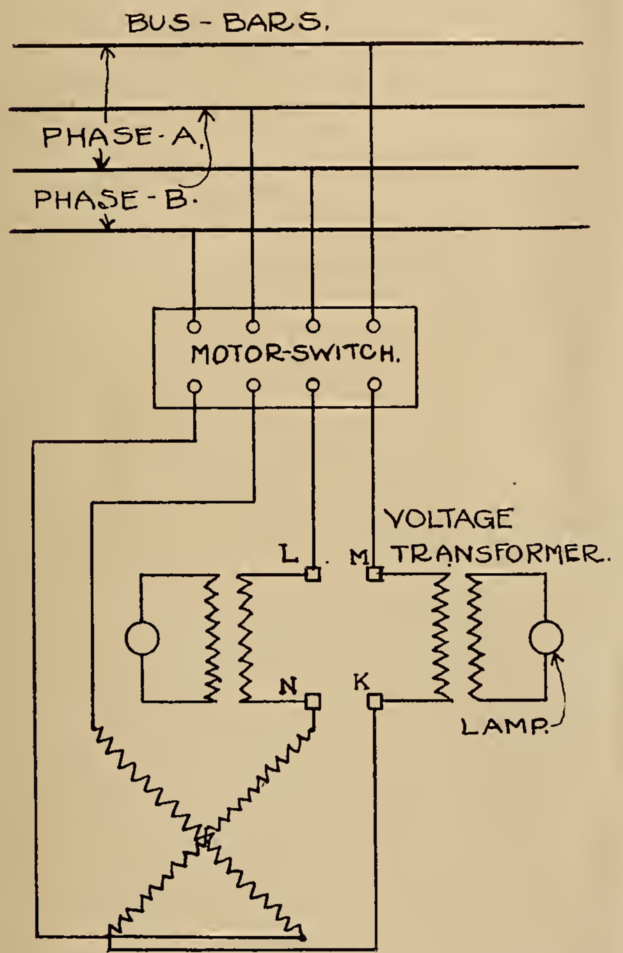


Fig. 2. Connections for Test of Two-Phase Machine.

of potential between these points. This may be conveniently determined by bridging the primary terminals of a suitable potential transformer across these points.

Hence, a lamp connected to the transformer secondary will remain dark, indicating the connections are correct to produce the direction of rotation in which the set was first started; that is, the rotation for the starting and main motors will be alike. The main switch is then opened and the lead A closed at L-M. The connections will then be correct to start the set in the regular manner and with the assurance that the main motor will not tend to reverse the rotation upon closing the main switch.

However, should the lamp burn bright, it will indicate a difference of potential across L-M and any two of the motor leads must be reversed to produce the correct rotation. It should be remembered that reversing any two leads of a three-phase motor will not effect the direction of rotation as a single-phase machine. After these changes the same test should again be made to prevent errors.

This test is applied to a two-phase equipment in be satisfactory for low voltage equipments. Again in Fig. 2 the primary leads of the transformers may be criss-crossed; that is, connected between L-K and M-N, respectively, then indicating correct connections by bright lamps. Further, for a two-phase motor only one lead of either phase need be opened, as at L-N or M-K; in which case the difference of potential will be approximately double the motor voltage for wrong connections, or about zero for the correct arrangement of leads.

Taking into consideration all of these facts, it will be apparent that the test for both synchronous and induction motors is identical after the machines are running single phase. The former, however, must be in synchronism with the system before connected, even a similar manner, except that each lead of the idle phase is opened as in Fig. 2. Two transformers with primary coils wound for the motor voltage are required. The transformer secondary and lamp voltage must also be alike. Both lamps will remain dark when motor connections are correct. If the lamps indicate wrong connections, the leads of either phase must be reversed.

However, with a three-phase motor the voltage across the terminals L-M may be twice the motor voltage, since with wrong connections the electromotive force induced in the idle phase and that of the supply circuit will be in series. Thus, a 4400-volt (primary winding) transformer will be required with a 2200-volt motor.

Transformers for double the equipment voltage are often not available. In such case transformers wound for the motor voltage will be suitable if connected only momentarily during the test, since any good potential transformer will stand double the normal voltage when applied in this manner. The condition of the lamp and transformers should always be checked by testing across one phase of the line or motor. This precaution will always eliminate a possible chance for error.

Certain modifications of these connections to produce the same results are possible. As an example, a voltmeter may be substituted for the lamp, or a number of lamps instead of a transformer and lamp will as a single-phase machine, while the induction motor need only be brought up to approximately normal speed.

A further application of these principles will explain why starting or protective devices for polyphase motors are usually equipped with only one no-voltage release attachment. Additional protection is not afforded by having a release coil across each phase, since failure of voltage on one circuit will permit the motor to run single phase and by feeding back into the idle phase will keep the no-voltage attachment from acting. In the connections for a modern auto-starter with one no-voltage release coil the usual fuses are replaced by relays which open the no-voltage coil circuit in case of overload, allowing the auto-starter switch to return to the open position.

THE INDUCTION MOTOR AND GENERATOR.

Discussion by members of the San Francisco Section of the American Institute of Electrical Engineers of paper by F. G. Baum, published in this journal November 19, 1910:

S. B. Charters: The discussion from Professor Ryan was given to me in the form of a brief abstract of points to cover, and I will go over those of which I have made record. They follow much along the lines taken by Mr. Hillebrand.

The principal places at which the non-synchronous generator is being used, and the principal places in which it is probably going to be used, are where we wish to achieve further economies in the production of power. Probably the most important application of the non-synchronous generator is in connection with the low pressure or exhaust turbine. The turbine can be connected to the exhaust of practically any type of engine, and the electrical generator can then be connected solidly to the line without having to bother with switches and circuit breakers, because the unit will pick up load in proportion to the energy which is supplied from the exhaust steam. It is, in general, practical to put in sufficient low pressure turbine capacity to double the output of your station with only a relatively small increase in boiler capacity. That of course tends to a more economical production of power. In a recent paper in the Institute Proceedings[1] in connection with the Interborough Traction System it was shown that by the use of engines and low pressure turbines driving non-synchronous generators they are realizing a thermal efficiency of 20.6 per cent, which you can see is a satisfactory figure. As I said, theoretically the generator cannot be connected in on the line without taking any precautions. Mr. Hillebrand has also pointed out that that would be the case. Mr. Waters two years ago made a number of computations from machines running at 1000 kw. and 25 cycles up through 13,000 kw. machines and 60 cycles and voltages from 2200 to 11,000. In all those cases the maximum slip required to develop full load current was only one and one-quarter per cent, whereas in the minimum case not over .4 per cent slip was required to develop full load current. That eliminates to a certain extent the supposed simplicity, because if you cannot be out more than .4 per cent at the instant of synchronizing it is going to be difficult to get a unit of that kind on the line without causing a disturbance.

The next place where you can utilize power is in connection with small hydraulic power sources. When you have a main network once established and connected up with synchronous apparatus it should be theoretically possible, as small water-powers become available, to connect them in by providing a small water wheel and a non-synchronous generator at each power source. This is only possible in the development of a synchronous network, that is, a network embodying synchronous machines. Theoretically such a plant can be left to take care of itself. Practically it may be another story when you come to do it.

There is a further factor. It has been said that the non-synchronous generator requires current from the line for excitation. In a large network it is entirely possible that the capacity of the system, even supposing all the synchronous apparatus cut free from it, may be entirely sufficient to excite the generator, and allowed to run up its voltage. For instance, the capacity of the Interborough system in New York is sufficient to charge a ten thousand kilowatt twenty-five cycle induction generator without any synchronous apparatus being connected to the line..

In case just cited if only a 2000 kw. machine had been connected in there would have been sufficient exciting current to develop twice normal voltage.

In developing such water-powers it will be necessary to design the water wheels driving such units for much higher speeds than are now regarded as practical. If you are running it as a water-wheel is normally run, there is nothing to prevent the non-synchronous generator speeding up to practically the speed of the jet, that is, about double the ordinary speed, if the synchronous apparatus be removed from the line. In Mr. Waters' paper the large amount of current taken for excitation is also discussed. The smallest case shown, that for the turbine driven alternator, requires 8.1 per cent of normal load current, whereas for the gas engine case, sixteen per cent of normal load power is taken as exciting current. That current must be furnished from the synchronous apparatus running on your lines. You are affecting your power factor to that extent. If you had a large number of non-synchronous generators you might easily use exciting current enough to take all the capacity of your synchronous machines.

A combination of synchronous converter for instance and non-synchronous generator makes a very satisfactory unit and is free from practically all the troubles which are connected up with in operating a synchronous converter and a synchronous generator. On short circuit the synchronous converter loses its voltage, and therefore the entire outfit goes dead. That point is discussed in connection with the Interborough. As conditions are in the Interborough at present, before the installation of the non-synchronous generator, they figure that on their generators for the first few cycles it should be possible theoretically to develop approximately fifteen times normal full load current, and then settle down . On their synchronous converters it was possible to develop three times the normal full load current.

If they should put in a full complement of non-synchronous generators, with the coming of a short the synchronous apparatus loses its excitation as to kill the non-synchonous apparatus. The short circuit current is then reduced to the current which can be furnished by the synchronous converters, which of course is a very different condition of affairs from the one just mentioned, only about three times normal, as stated.

Another fact brought up is this: In such a system using non-synchronous generators and synchronous converters, or synchronous generators and non-synchronous motors, on the line, the control, as far as voltage regulation goes, is entirely from the synchronous machine. You have therefore sacrificed one-half or more of your ability to control conditions on the line, because you cannot do any governing from the non-synchronous unit. The voltage regulation must be controlled entirely from the synchronous voltage. As soon as you put in a non-synchronous generator you at once lose more than half your ability to control conditions on the line, which sometimes may be a decided disadvantage.

B. C. Shipman: The difficulty of throwing in non-synchronous machines seems to be exaggerated. I first had experience with such a machine eight or nine years ago when a water-power plant was furnishing power to a street railway. They had a 1400 h.p. motor, and they converted from 6600 volts, I think it was, to 500 volts d.c. The hydraulic plant became inadequate, and the power company wanted to buy power from the street railroad, so they made arrangements to take it back through motor generator sets. It worked practically. All they had to do was to cut out the compounding, and the attendant would go in in the morning to switch his shunt motor on anything he wanted to, and the induction motor as generator delivered power all day without any trouble. They had no trouble whatever in switching.

A later case was even more evident on that point. I had occasion to put in the plant. It was a 1200 kw. turbine unit, non-synchronous generator, and a 1200 kw. rotary. They used the current for electrolytic refining of copper. The voltage was 220. We used to throw those together without difficulty. There were three-section knife blade switches, and I think the current was somewhere around 1600 amperes per terminal, something of that kind. We had no difficulty in throwing them in

[1] The Non-Synchronous Generator in Central Stations and Other Work. W. S. Waters, Proc. A. I. E. E., 1908.

and took no precautions. The combination was put together without a bit of trouble; never had any trouble from it at all. So I think, if you could handle a 1200 kw. that easily, there would not be much difficulty in handling 5000.

A point in connection with that, but which has not been taken up at all, is the fact that the non-synchronous machine would counteract to a certain extent the rise of potential on the lines. It takes a lagging current to excite, and it would balance out the capacity to a certain extent.

If you had non-synchronous generators at the generating end, and rotaries at the receiving end, they would serve as very valuable regulating means, especially if these were used in connection with some automatic system of regulation. I know I have seen transmission systems, where the regulator kept the voltage absolutely uniform at the receiving end, and it changed all around at the power end. In fact the power-house, if it is any distance off, has very little to do with the voltage at the receiving end. They can't control it at all. So on the basis of the regulation it seems to me that the case against the non-synchronous generator is not strong.

P. M. Downing: From a theoretical standpoint this paper is interesting and no doubt to a man with the knowledge and ability of my good friend Baum its preparation is a mere matter of relaxation and pastime, but to those of us who have to do more with the practical operation of the apparatus, the theory becomes a harder problem.

The action of the induction motor is too well known to require any discussion. The field of the non-synchronous or induction generator has been discussed this evening, and what I say will have reference more particularly to its use in connection with large transmission networks.

It has been brought out by each of the three speakers thus far that this type of machine has a wide field in connection with taking care of the capacity current incident to long transmission lines of high voltages.

If you can conceive of a transmission system having no load or one with a large synchronous motor load and the motors operated with fields over-excited, then you might have a condition where the induction generator would serve a useful purpose. As a matter of fact this condition does not exist and for that reason the induction generator has never been used for the purpose mentioned by the previous speakers.

The commercial load as handled by any long distance transmission system is made up to a very great extent of induction motors and is, therefore, of low power factor. Every induction motor and every induction generator that you put on that system takes additional wattless current, which is the greatest bugaboo with which the transmission engineer has to contend The lagging current more than offsets the leading current due to the capacity of the line and to such an extent that it is common practice to install synchronous generator capacity much in excess of the actual kilowatt load to be carried, in order to handle the wattless current due to the low power factor.

I can readily see where an induction generator will serve a useful purpose in a station, such as that of the Interborough Company in New York, where there are large units of power with little inductive resistance in the line between units, but with a network where the generating stations are far removed from each other, I am unable to see where the induction generator could be used to advantage..

In the early days of long transmission on the Pacific Coast it was thought that troubles from high voltage, such as have been mentioned by the previous speakers, would be experienced. To keep this voltage down, or in other words, to neutralize the capacity current, reactance coils were installed, but it was soon found that they were unnecessary, and were never used except for experimental purposes.

At the present time the company with which I am associated is putting in a synchronous condenser to take care of this wattless current. It might also be interesting to note that the synchronous condenser is being installed in the identical station in which the reactance coils were originally placed, in fact the reactance coils had to be moved out of place to make room for the synchronous condenser.

The conditions being as I have stated them, I can hardly see where there is any field for an induction generator on a hydro-electric network supplied with power from generating stations at considerable distances from each other.

B. C. Shipman- All cases are not networks. Sometimes you have to generate your power at one place and transmit it as a whole to other places, and there you may use it for other purposes than induction motors, so in that case your induction current would be quite a serious matter for handling.

P. M. Downing: I would consider that a special case. The discussion this evening has all been along the line of general networks. Where power is generated at one point and transmitted as a whole to another, the conditions are somewhat different as you would no longer have the network.

I do not think the matter of first cost should be the determining factor. Continuity of service must be given first consideration, and with the difficulties which have been brought out and which are apt to arise when synchronizing the non-synchronous machines with your transmission line, it seems to me that after all the simplicity of the induction generator is not a very great recommendation for its use.

S. J. Lisberger: What Mr. Downing says is absolutely correct. I wish Mr. Varney were here tonight to tell you of some changes that he is making in San Francisco in his department. He is re-winding some 1000 kw. motor generator sets where the motors are now taking current at 11,000 volts. Those motors are being rewound for synchronous operation instead of induction. I asked him just what his saving was in efficiency, he replied he did not have his figures with him, but recalled offhand that at full load the 1000 kw. set as induction motors took about 62 or 63 amperes; with synchronous machines it dropped down to about 51 amperes.

P. M. Downing: Better still if he would take 62 amperes leading current.

L. R. Jorgensen: If I should say anything it would be much of a repetition of what Mr. Downing and others have just said. The most important installation of induction generators today is as far as I know the installation of the Interborough Rapid Transit Co. This installation seems to be successful, but there are in this particular case several favorable conditions which make this kind of generator particularly adaptable. First, this station works in parallel with other big stations; therefore the current rush during a short may be very heavy with many synchronous machines feeding this short circuit. With induction generators this would not be the case. Then also this station feeds a large cable network, and the condenser effect from the cables may be able to neutralize the magnetizing current drawn by the induction generators, so that after all the lagging current introduced into the system by the induction generator is not a disadvantage. If the station capacity in synchronous generators is twice or more the capacity in induction generators, the effect of this lagging current is not so pronounced.

On our water-power systems in the West it is not so necessary to keep down the amount of power in synchronous apparatus, even if they feed the same system, for the reason that the reactance of the long interconnecting line will prevent a rush of current greater than the switching apparatus can take care of, and we seldom have leading current to spare. For small stations connected to a large system however, the induction generator should be of advantage in greatly simplifying the station and attendance, that is, if the system can stand the lagging current introduced.

For medium sized steam plants I see advantage in their use only if the power factor of the load is close to unity, and especially if leading, which it seldom is on a loaded system.

So far as synchronizing is concerned I do not see so much difficulty in that, especially if the reciprocating engine and low pressure turbine are started at the same time, the induction generator will run as a motor a little below speed at the time the synchronous generator is ready to throw on the line the speed of the induction generator will be but little below synchronous, and little trouble should be experienced. We could also have a little steam in the turbine to help out. After the synchronous machine was on the line full speed could be put on the turbine to make the induction generator run above speed and take load.

S. J. Lisberger: I think the conditions on the Interborough system would have been different if they had a 60 cycle system. The probabilities are they would not have rotaries such as they have, and the induction generator would not have been such a long felt want in this particular case.

I would like to ask some of the maufacturing gentlemen what is the difference in price per kilowatt. Does anybody happen to know the difference in price per kilowatt of the two units?

W. W. Briggs: I don't think there is any data on that. I think the price per pound is about the same.

S. B. Charters: I believe in the discussion of Mr. Waters' paper in 1907 that point was taken up. I believe the point has been made that it is a much cheaper installation. They make the point that you eliminate all your exciting apparatus, your apparatus for synchronizing, and you can operate your engine without a governor except for over-speeds. Figuring all that in I believe they arrive at the conclusion that the non-synchronous generator should be much cheaper in proportion to install, but I don't think anybody gave any actual figures on it.

I agree with Mr. Jorgensen that the paper points out the disadvantage of throwing the machines on the line at the speed corresponding to maximum torque. It says if the machine is thrown on at lower speed the desired result would be obtained. Now is it not a fact that if the induction generator or motor, as the case may be, is thrown on to the line at low speed, of course there won't be the maximum torque at that point; but as the machine comes up to speed, when it does attain the speed corresponding to the maximum torque, that the torque will occur at that point? Isn't that just as bad as if it were thrown on the line at that point, and how would that be overcome? You could not overcome having that high torque when the machine came up to speed unless you decreased the voltage. That would introduce another complication into the system.

Mr. Baglor: One thing I did not understand as being brought out in the paper, that is, will this improve the power factor on the line? I understand this is going to put leading current into the line from the induction generator. It will not improve the power any?

S. J. Lisberger: No, on the contrary, it will decrease, because it takes a lagging current from the system.

A. H. Halloran: The discussion this evening has had a tendency to get away from Mr. Baum's theoretical treatment, into a more practical—and perhaps a more useful one. Mr. Baum's idea is to explain by the graphical method the action of induction machines, first of a transformer, then of an induction motor, and finally of an induction generator. When this graphical method is understood, the analytical method of Steinmetz will be clearer. There are some men that can think in mathematics and the calculus, just as some can think in German, or in the metric system without need of converting into English words or into English units; but the great majority of us want a picture. That is what Mr. Baum has given.

Carrying the pictorial method one step further, there are many men that cannot even follow the mathematics, simple as it is claimed to be, in Mr. Baum's paper, and require some simpler conception of what an induction generator is. I remember seeing a great 20-mule team hauling oil in the mountains. There were two fast horses at the head of the team. They stepped along lively and set the pace for the rest. Those horses would be just as good if driving a light buggy on Sunday as they were pulling this heavy team on Monday. But they are likely to run away; they get excited, and commence see-sawing back and forth on a steep grade and may lose the load entirely, while on the down grade they are likely to run away. They require some steadying influence that will pull harder on the up grade and hold back on the down. This is provided by the wheelers, who work well in tandem but are too slow and heavy to be driven alone, being mere machines giving power to the machine, but not concerned with the speed.

A little thought will show that the synchronous generator corresponds closely to the leaders in this 20-mule team, and that the induction generator corresponds closely to the wheelers. The induction generator gives current only when connected to a synchronous machine and has no independent voltage. It feeds power into the machine but does not participate in the regulation. The synchronous generator supplies a large amperage on a short circuit, thus being like the leaders on a down grade, but the induction machine ceases to generate when short circuited.

POLES PURCHASED LAST YEAR.

The total number of poles reported to the Bureau of the Census as purchased during the calendar year 1909 by the telegraph and telephone companies, steam and electric railroads, and electric light and power companies of the United States was 3,739,000, as against 3,249,000 in 1908 and 3,283,000 in 1907. There were purchased in 1909 by the same class of users 3,509,000 cross-arms, 6,168,000 brackets, and 18,463,000 insulator pins. Cross-arms, brackets, and insulator pins were not included in the annual census of lumber and timber products prior to 1909.

This information appears in a preliminary comparative report covering 1909, 1908, and 1907, which has been transmitted to Census Director Durand by Chief Statistician William M. Steuart, under whose supervision it was prepared by J. E. Whelchel, expert special agent of the Division of Manufactures. In co-operation with the Forest Service of the Department of Agriculture, the Bureau of the Census annually collects and publishes statistics pertaining to the group of lumber and timber industries.

Telephone and telegraph companies reported purchases during 1909 of 2,916,000 poles, or 78 per cent of the total. This was an increase over 1908 in the number reported as bought by this class of users of 354,000 poles, or 14 per cent, and over 1907 of 604,000 poles, or 26 per cent. Steam railroads reported the purchase of 26 per cent more poles in 1909 than in 1908, though 34 per cent less than in 1907, while the reported purchases by electric railroads and electric light and power companies were 18 per cent greater than in 1908 and 7 per cent less than in 1907.

There was little change in the average cost per pole of all lengths and from all species of wood in 1909, as compared with 1908, it being $1.89 in the later and $1.82 in the earlier year. The average cost per pole, $2.46, in 1907, was substantially larger than in either of the later years, mainly for the reason that a class of pole consumers in the United States which uses chiefly short poles was not included in the census for 1907.

Of the total outlay during 1909, $1,621,000, for cross-arms, brackets, and insulator pins, the telegraph and telephone companies contributed 63 per cent, electric railroads and electric light and power companies 32 per cent, and steam railroads 4 per cent.

EXPERIENCES PACIFIC COAST GAS ASSOCIATION.

EDITED BY LEON B. JONES.

A Service "Check."

The local printing office and publisher of one of the daily papers, sent in a no-gas complaint. Upon investigating, the gas at the meter inlet was good. The outlet was opened to see if the meter was stuck, but instead of finding the cause to be such, the brass-check (under separate cover) was found reposing in the connection.

The editor of the paper was consulted to determine the object of the thing. He stated, that the Gem gas bill reducer, cost him $3.50 and was a protection to prevent what gas passed through the meter once from again running back to the main, when gas was not in use by the house. He, the editor, fully believed this to be a fact, and stated that the confidence man (from whom he purchased the bill-reducer) showed him testimonials from a number of publishers as to the ability of the check.

The trouble man suggested to the editor that he place a few brick-bats on the meter and tie a wet sack about it, and maybe he would reduce the gas bill.

A Box of Gas.

Some while ago a family moved in town from a farm. They had not been accustomed to the use of such necessities of life as gas.

They were persuaded to use gas, as connections were in the house they moved into. For the first month or so they got on very well, the quantity of gas used was above the average; until one month the gas used did not equal the meter charges. This fact was noted by the bookkeeper, and thinking that something might be wrong with the meter, ordered it to be changed.

When the man reached the house with the new meter, a woman greeted him with: "Well! I thought it about time that you brought around another box of gas."

How the Leakage Was Quickly Reduced from 45 to 7 Per Cent.

"Once upon a time," so began many of the fairy stories of our infancy, but this is an account of an actual occurrence —the writer was invited to take charge of an Eastern gas works, where the alleged discrepancy between make and accounted for gas had all at once started to climb from 10 to 40 and 45 per cent and for several months had stuck to the higher figures.

The president of the company was an old ex-soldier and had threatened to do something desperate to himself unless the trouble was soon located.

The superintendent, then quite a young man, and now one of the best general managers in the business, said the president was welcome to act on his own suggestion; but as for himself, having done all he could to find the trouble unsuccessfully, he was willing to let some one else try his hand.

The writer, for the first month of his second incumbency of that position (for ten years prior to the above, he had been in charge of the same plant, and had partly rebuilt it), let things go their natural gait, but watched all closely; and found everything working well. But at the end of the month the unaccounted for gas loomed up 45 per cent just the same.

The station meter showed a certain amount of gas had passed through and had been duly recorded. Coal and water gas was being made and with a large stock of material on hand, for it was winter, the checking up same was not so easy.

But if 45 per cent of gas leaked away, some odor should have been perceptible somewhere. We had been barring the street mains for leaks, finding a few unimportant ones which were repaired. Where could all this gas have gone to? The station meter had been tested and found correct. The gas holders, three of them, were reasonably tight. And just at that point the writer began to suspect something. Toward the end of his first engagement with that company the manufacture of water gas had been introduced. But that was at a time when the relief holder was not yet known, and when we had only two holders, which were connected with a 12-in. valved main, so that No. 1 holder could be filled from holder No. 2, which was the heavier. In the following years during which the writer was at a western works, holder No. 1 was made the relief holder for the water gas apparatus, and a third storage holder was added.

There were three or four changes in the superintendency also, and the connection between holders No. 1 and 2 was forgotten, or overlooked(for I had left a good ground plan of the works when going west in 1883). It occurred to me to look up that main and valve and found it to be both accessible and surprisingly easy to operate for a valve supposed to have been so many years out of use. I jammed that valve fast with a crowbar, filled in the hole on top of it myself, said not a word to anybody about it, and the next month our leakage had been reduced to less than seven per cent.

As a sequel to the preceding narrative the following may be interesting. Soon after discovering the cause of the supposed enormous leakage, and stopping same, it was found that more coal and oil was used (apparently) than either the quantity or quality of gas made warranted.

The carbonizing sheets showed the usual number of runs made, as well as all other data corresponding; but while the candle-power grew no better the quantity of gas was less.

So I procured a recording pressure gauge, connected it with the relief holder inlet, and found the trouble inside of twenty-four hours. The night gas-maker did not make any gas from about two until 5 a. m.

This could be clearly seen beyond room for doubt upon the pressure gauge registry card which would—as you all understand—show a decided increase in pressure whenever a new run was started in the apparatus.

It was a surprised gas-maker, when the next morning he was told by the writer of this undeniable dereliction of duty; and that, with the former discovery, caused the cessation of further attempts to find out if or not "the old man" knew his business; especially as it was told the working force in impressive, if unprintable, language what the consequences would be "the next time."

How a Process Was Born, or "Necessity Is the Mother of Invention."

In July, 1883, the writer was appointed engineer and superintendent of the Laclede Gas Company, of St. Louis, Mo., and found the following conditions:

The city was divided into two gas districts. South of Washington avenue was supplied by the "St. Louis Gas. Co.", and the price of gas was $2.50 per thousand cubic feet. The district north of the avenue named was furnished with gas by two companies; the first and older being the "Laclede Gas Company," and the other, or oppositon, was known as the "Light, Heat and Power Company of St. Louis."

The works of the latter company were located in the old St. Louis Gas Company's district (occupying part of the ground now used as the Union Station), but sold gas only in the Laclede's district, charging $1.00 per thousand cubic feet; the Laclede Gas Company's price being limited by law to $1.50 per thousand. Coal gas was made by the first two and water gas by the latter of the companies named; which was started strictly as an opposition to the Laclede. The "Light, Heat and Power Company" in canvassing for business not only used the reduction in price as an argument, but asserted—to convince subscribers that they would not afterwards raise—that water gas was naturally just as good as coal gas; while it could be made ever so much cheaper "because it

was largely made from water or steam which cost very little." The situation was beginning to look serious to the Laclede officials when the writer was called and placed in charge by the president of the company. Under then prevailing local conditions it was seen that coal gas was by far the cheaper to produce, notwithstanding the specious logic employed by the opposition company to get consumers, and in which they were quite successful.

The water gas company were operating the Lowe process, and we could not get a license to use this. Other methods to produce water gas were offered, looked into and declined, because they appeared to be palpab.e infringements of the fundamental Lowe patents.

So then the writer decided to invent a process which would at least enable us to also manufacture water gas—if we wanted to—and thus meet the arguments of our opponents, "fighting the devil with fire," as it were. The method decided upon was to use a cupola somewhat like the so-called "Springer process," which by the way owed its successful operation to the remodeling by the writer one year before at Chicago, for in its original form it was a dismal failure. Then, instead of using a blower and air pressure to bring the fuel to incandescence in the generator, we employed an exhauster and drew the necessary air through the fuel bed; and thus the "suction gas process" was born. It is true we made only blue water gas in the generator, but we did it with a notably smaller expenditure of fuel than was done in the air blast machines. The gas was carbureted with oil gas made by a simple but effective method in our ordinary coal gas retorts; and after a few improvements made to the original apparatus, we found that we had a pretty good water gas process, which fully served our purpose as previously indicated. We then likewise reduced the price of gas to $1.00 per thousand cubic feet. Our canvassers could tell our patrons that we also were making water gas, which we did, too; about one-third of our make being such; and we fought our opponents to a standstill in a little while.

A "Near" Asphyxiation.

A most unusual accident (as well as a very humorous one to all except the victim) occurred in Los Angeles a few weeks ago.

While a captive balloon, inflated with ordinary illuminating gas and being operated at Eighth and Broadway, was preparing for an ascent, one of the men in charge attempted to smooth out some wrinkles near the top of the balloon by climbing up the rigging between it and the gas bag. Just before reaching the top he stopped to rest, and in doing so allowed too much of his weight to press against the well filled bag, causing it to rip. Of course the imprisoned gas immediately rushed out, tearing the slit larger as it issued forth. The man clung to the network of ropes like a fly to a wall until overcome by the escaping gas, when he dropped and disappeared through the hole in the balloon.

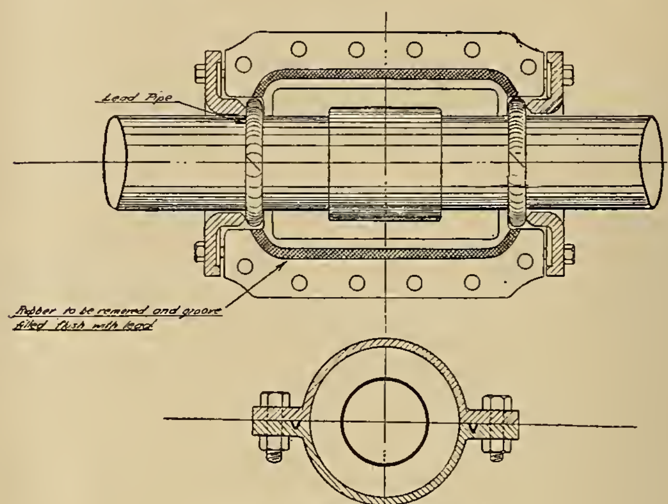
There were several eye witnesses of the accident, and it required only a few seconds to cut a hole in the bottom of the bag and allow the unfortunate victim to drop out. A cool-headed individual who happened to be near, immediately secured an oxygen tank, the contents of which, together with other restoratives, were administered to the unconscious man. After about forty-five minutes of strenuous work, including artificial respiration and the rolling of the victim over a barrel, he regained consciousness. He was at first somewhat delirious, but in a very short time was well and sound again, and able to assist in repairing and refilling the balloon.

Centrifugal Pumps.

It may not be generally known that the head or pressure against which a centrifugal pump will work can be raised or lowered by a change in the design of the runner, with no other alteration. We recently had occasion to change a pump designed to pump against 15 lb. per square inch, to work against 40 lb. This was done by simply changing the runner, at a small cost, and the pump is perfectly satisfactory.

Experience With High Pressure Joints.

We have considerable trouble on a 10-in. high pressure line, which is casing connected with Dresser couplings used with rubber gaskets. No cooler is used except the storage



Dresser Repair Sleeve
substituting
Lead for Rubber Gaskets.

tank, and consequently the gas is sent out very hot. This heat expanded the joints to such an extent that the benzol in the gas had a chance to act on the rubbers with a result that the rubber, after softening up, finally blew out of the joint and leaked. We had these repair sleeves on hand. They are the standard heavy repair sleeve of the Dresser type intended to enclose a Dresser coupling, and they are made up with rubber gaskets. As we found the rubber gaskets would not last under these conditions, we decided to try lead in place of the rubber. The rubber in the split sleeve itself was pulled out of the crevice and this run even full with lead. We then used some standard ⅝ lead pipe, cut two lengths sufficient to make a gasket with a diagonal joint, as shown, and used these in place of the regular rubber gasket. We had no trouble in pulling up this repair sleeve complete and gas tight, and they have given us no further trouble.

Use of Dresser Couplings for Emergency Repairs.

For some time we have used Dresser couplings for our high pressure gas lines about the works with great satisfaction. A while ago we had a break in an important hot oil line, and by the use of these couplings it was put back into service in a very few minutes, while to install a flange coupling would have necessitated cutting several threads and consumed a half hour or more.

Now we keep all sizes of these couplings on hand for such work and they have saved us from trouble several times. We have used them on steam, water, hot oil, compressed air, and, in fact, all kinds of connections, and find them perfectly satisfactory for emergencies. When we have the opportunity we then replace them with permanent construction.

We have one 4 in. coupling on a hot oil line which carries 100 pounds pressure. It has been in place three months and shows no sign of giving away. This is being carefully watched to see if these couplings can be used as permanent connections.

A Method of Handling Purifying Material.

The writer's experience in handling purifying material, particularly where the purifying boxes are scattered around different portions of the gas works, may be of interest.

The particular experience in question was gathered while operating the gas works at St. Louis, Missouri. At the various gas plants in St. Louis there were a number of sets of outdoor purifiers situated in different portions of the gas works and generally of steel cylindrical construction, more or less of the cheese box type, and these boxes were as high at the edge as 16 in. in some instances. There were openings on top of these boxes some 5 ft. in diameter and also openings on the sides large enough for a man to wheel the material in which a wheel barrow upon temporary wooden staging erected for that purpose.

The largest of these boxes were 40 ft. in diameter by 16 in. in depth at edge, and owing to the considerable number of these boxes and the scattered location of same, a mechanical contrivance for easily and economically putting fresh purifying material into them became a necessity as well as an interesting study.

The cost of filling these large purifiers was considerable. The plan finally adopted was to construct a simple portable bucket elevator made up of two iron channels long enough to reach from the ground to well above the boxes. A belt carrying the buckets ran between these channels over proper wheels at both ends and at the top discharged into a spout which might be turned in any desired direction.

At the bottom of the machine a simple steel frame work carried an electric motor which was used to operate the bucket elevator. A small steel hopper at the bottom completed the features of this equipment.

The whole contrivance was mounted on wide flanged iron wheels so that two men could readily push it around the yard and up to any of the purifiers it was desired to fill. Electric wires with convenient sockets were installed near each set of purifiers so that rapid connection to the motor could be made at any desired location.

The operation of the machine was simple. The man wheeled the fresh oxide up to the hopper by means of a small runway and dumped same into it. The bucket elevator hoisted the oxide and discharged it by means of the spout into the portions of the boxes.

The entire outfit cost comparatively little money and effected a great saving in the cost of filling these purifiers, and as the same was portable, it could be used almost anywhere where electric wires could be run.

It occurred to the writer that inasmuch as a great many purifiers in California were out of doors owing to the wonderful climate of the Pacific Coast, that such a device might become useful to some of the members of the Pacific Coast Gas Association. In the writer's experience the machine was found equally satisfactory when used in-doors, and as it was pushed around on wheels, it was easily possible to bring it into any ordinary purifying house through a large door.

An Experience With Automobile Head Lighting With Blau Gas.

Blau gas is an ingenious result of the compression of oil gas to 1500 lb. per square inch into a liquid form. This liquid is then expanded into gas at a pressure of 25 lb. per square inch, and then reduced to 12 in. water pressure by the use of the ordinary high pressure regulator.

The writer had the privilege of being present at the first test of this new illuminant for automobile lighting. A fiat landaulet was fitted with a small steel bottle of liquid Blau gas containing about 2 lb. of the liquid. One pound of Blau gas expands into about twelve cu. ft. of the illuminating gas and a pound of the liquid will supply a 60 c.p. incandescent light for about 17 hours. The steel bottle and expansion tank occupied but small space and were fastened to the running board in a manner similar to the Presto-light. The gas was led to the headlights through small copper tubing and was applied directly to inverted incandescent mantle lamps which had previously been used for alcohol vapor. These were the best to be obtained and were but poor expedients. The party left Long Island City, making wide detours over the roads of Long Island to Long Beach, returning to New York City by way of the Williamsburg bridge to the Hotel Manhattan, a distance of 65 miles in four hours' time.

The lamps were lighted at Long Island City, and remained lighted during the entire trip with the single exception of a few minutes when the gas was shut off by the motion of the car shutting the gas valve.

The trip was made over the roughest roads imaginable and with little hope of success, but at the end of the journey the mantles were uninjured and the illumination was exceptionally good as the Blau gas heated the mantle to full incandescence, and the light was entirely without shadows on account of the use of invert mantles.

This experience was novel as it demonstrated the safety of transporting and using liquid Blau gas with rough handling.

DISCUSSION OF PAPERS AT EIGHTEENTH ANNUAL CONVENTION PACIFIC COAST GAS ASSOCIATION.

"Municipal Inspection of Gas and Gas Meters."

Mr. Clements: Mr. President, I enjoyed Mr. Schade's paper very much indeed. It comes within my province and general routine to meet the public almost every day for some complaint, and I know how they feel toward that little instrument—the gas meter. As I said in a paper which I read before the Association, I think at the last session, I called upon an eminent gentleman in the city where I live, who made this remark, "That gas meter of ours seems to have a sort of intuition to help you people at the time when you need money." "Now," he says, "this is the month of December. This is the closing of the financial fiscal year. Why, all around in this neighborhood among all my friends, I find the bills have been increased. Why do they do it? Evidently to assist the company or the officers of the company to make a good showing to the directors and increase the percentage of income—in other words to pay their annual dividends." Coming from a gentleman of the type he was, it seemed ridiculous, and of course, I thought he looked upon it as a joke, but pinning him down he actually felt quite earnest about it. He thought that the meter could do just about like it wanted to.

But I find there is one feature about the gas meter that does not seem to work exactly right, and that is, it so often overlooks that people have gone away on vacations, and while they were not using any gas the meter kept on recording. That is one thing about the gas meter I think we should correct, and I hope the City Inspector will look to that for the benefit of the company.

Thaddeus Lowe: I thoroughly believe in municipal inspection of both gas and gas meters, but I do not believe that municipal bodies should have the authority to say anything as to the quality of the gas. I believe that companies should be allowed to sell any quality of gas they choose, and make a price in accordance therewith. I believe the future gas will be one that has low candle-power, and which can be sold to the consumer at a much lower cost. I believe it is more or less municipal interference to regulate the quality of gas. I believe that as far as municipal inspection relates to the quality it is entirely wrong, and that municipalities should establish a price based on quality, and allow the gas company to sell any quality of gas they choose, as a merchant would sell any quality of wares he chooses. I think this is an important point, because today the municipalities regulate the quality which we must live up to, and it does not give us an opportunity to develop along the lines of low quality at a less price.

President: If you do sell a lower quality of gas I think they would have to take some means to determine the quality supplied.

Thaddeus Lowe: Oh, yes.

President: That would necessitate the employment of the city inspector still.

Thaddeus Lowe: Oh, yes.

Mr. Britton: Having been guilty for a great many years of imposing these instruments upon the public, I am strongly an advocate of Mr. Schade's position. People, in masses, are like children—they need a governing hand. The corporation that seeks to govern the people by its own rules and regulations is looked upon naturally, with suspicion, but anything today that is instituted by the government, whether municipal, state or national, is looked upon by the masses of the people in a favorable light, as a God sent Savior to save them from the sins of the corporation, and you can always make more by running with a crowd than you can by running against the crowd, and I believe today is a period of time when the corporations should run with the crowd, and the crowd is greatly tending toward the regulation of corporations, especially public service corporations. But behind that all it seems to me there is a question of justice there, even as against municipal inspection, and that is the personal attitude of the corporation to the consumer. I think in California today we need more municipal inspection in every city, because by that we gain what we cannot obtain in any other way—publicity. Through municipal bureaus the actions of public corporations will be discussed. Unfortunately the corporation side is seldom given space, but the argument against is given full space. I have never known a case where municipal requirements as to heat units, candlepower and general quality of gas did not serve to quiet ninety per cent of the disturbing element in the public and for the reason, as I said before, that they have absolute confidence in the officers of the municipalities, appointed for the service, who are, as a rule, disinterested men seeking to follow out the dictates of the law appointing them. I have not met one inspector who has not been ready to listen to the side of the corporation, and give it all of justice that is due it. Now the time is past in the history of corporations when we can "Vanderbiltize," so to speak, the public—that time has past. The type of corporations that are co-operating with the consumers do more toward rendering municipal inspection unnecessary than any laws we may seek to pass in our own business.

Mr. Newbert: The question of municipal inspection of gas and gas meters is one that I have given a great deal of thought for some time. In fact, I have read a great number of reports of State commissions and associations. In the larger cities like San Francisco and Los Angeles, where the municipality provides an inspector, the companies, I consider, are fortunate. However, in the smaller city, like most of us have to deal with, we have no municipal gas inspectors, nor will those small cities go to the expense of providing a municipal gas inspector. Therefore the whole question resolves itself into what was brought up in this morning's session of having in this State a commission similar to the commission in Massachusetts, Wisconsin and New York. The public service corporations of this State would be subject to the rules of the State commission instead of the rules and regulations of municipalities.

Mr. Schade: Mr. President, members of the Association, I would gladly and cheerfully agree with you if I knew where I would come out. I would not like to be in the position of the Irishman who got hit with a brick, and turned his case over to a lawyer to have him fight it, and sue for a recovery. So after he recovered he notified the Irishman to come to his office, and the lawyer handed him $50. The lawyer said, "Here is your damages." "Well, he says, "that is $50; how much did you collect?" "Well," he says, "including your damages and the costs, $500.00." "And I get $50.?" Say, he says, "which of us two fellows got hit with the brick?"

Now, Mr. President, I would like to make two statements. I don't want to cast any reflections on anyone, but there are two points to be considered—one is with regard to what Mr. Lowe spoke of, that is, as to the quality and the amount of heat units the gas should carry. One thing is, you all know if it wasn't for the awful, awful reputation that the gas companies have in all respects, it would be all right, but you can't convince the people that you are giving them a square deal in this generation. Another thing is I am satisfied that the councils that have municipal gas inspection in hand have made real investigations, and ascertained from competent men just what can be done in that line, and I believe the gas companies are just as well off with municipal gas inspection as without it, though, in supplying different kinds or qualities of gas as Mr. Lowe spoke of, for instance where there are more companies in a city than one, and they make gas of 750 or 680, etc.—now, how are you going to do this—who is going to get the cheapest gas? They are not going to have pipe lines all over where people can jump over. No, the good gas comes on one corner and the cheap gas on another. Now, there will be a free-for-all fight there in a minute. I believe the municipalities as well as the State and representatives—that they thoroughly investigate the matter. To show you the methods, a letter was received at my office from the State Librarian of New York, making inquiries and asking for a report, and he said it was for the benefit of the State Senators and the State Public Utility Commission, so you see they are sparing no means to make an impartial investigation everywhere. I had another letter from Washington, D. C. They are trying to give everyone a fair and square deal.

E. P. Lowe: Mr. Schade hits the nail nicely on the head when he tells us that the gas company needs the municipal inspector to tell the public it is honest. We are all selfish; it is human nature to be selfish. We know nothing about the golden rule, save in theory; between individuals we may practice it but between the general public and the gas companies it needs the recognized servant of the people to teach them the honesty of the gas company. It is the best and cheapest way to teach, and if we had to pay the gas inspector ourselves we would better do it.

Mr. Schade: I wish to say for the benefit of the gas manufacturers here that they need not fear municipal gas inspection. It is for the benefit of the corporations and the individuals both, and I think I can say that without prejudice or partiality. I believe I have done more work in Los Angeles since I have been in office than the company could have done with one hundred men taking my place on the outside. The gas companies are a thousand times more honest than the public ever was. The consumer likes to get just a couple of feet for nothing, but they are not willing to pay one cent more than they ought to. One lady whose meter was closely correct called me in, and after talking to me says: "Say, Mr. Inspector, would you fix my meter a little slower?" I said: "I have not authority. You called me over here to give you a square deal. You would not believe the company's man. Now you ask me to fix your meter slower. If I did what kind of a fix would I be in? It would not be two hours before your next door neighbor would know that I fixed your meter.

Thaddeus Lowe: I don't want you to think for one moment I am against any meter inspection; we need it. I am perfectly satisfied with our experience. In Pasadena I think there have been four meters tested under their ordinance, and in every instance it was in favor of the consumer. The consumer has to pay for inspection and we have not had any trouble since.

Mr. Schade: During the last winter I had more than 350 calls from people wanting their meters inspected. I don't think I inspected one out of twenty-five, because when I go there and ask them the trouble, I usually find out that the meter is all right, and I would give them instructions as to how to use the gas and the appliances, etc., and tell them, "Now, try for another month, and if you are not satified at the end of this month, let me know and if the meter is wrong; if you were charged more than

you should pay—I will see that you get your money back, whatever the amount may be, because it is a physical impossibility for a meter to increase its record without more gas going through."

"Suburban Distribution."

Mr. Jones: Gentlemen, Mr. Newbert has had a large and successful experience in the distribution of high pressure gas on the peninsula south of San Francisco. One of the ambitions of my life is about to be realized, in the construction of a steel bracelet around the city of San Francisco for feeding the low pressure system. This main is now in the ground and is sixteen inches in diameter; a heavy steel tube joined together by rubber gasket joints, and the length of the main is 7½ miles. It extends from the old Potrero gas works, almost around the city to the old plant we call the North Beach Station. In the construction of this pipe line, we tried to profit by our former experiences, both in the coating of the steel pipe, and the joining of the pipes together. You will remember in a paper read some years ago, it was thought that red lead, properly ground in oil, was the best protective you could get for a steel pipe. We afterwards found that there was a granulation of the lead, which would take place after it had been in the ground for a considerable time, leaving the pipe exposed. After that we put on a second coat, an outer protective coat of good metalic paint, to protect the red lead. This worked fairly well, but was not entirely satisfactory. In casting about for a good coat for this new sixteen-inch main, which is, as you all know, very expensive and hard to repair, we found a substance consisting of coal tar pitch. This coal tar product was brought from Australia. First the pipe is cleaned, then a thin coat is applied with a brush. This first coat seems to amalgamate with the small particles of rust that may be on the pipe, and gives the first coat a good grip to the pipe. Then we take an enamel and apply it boiling hot, at a temperature of something like 300 degrees Fahrenheit; this will cling closely to the pipe, and has no tendency to peel off. We enamel the pipe to a thickness averaging one-eighth of an inch. Before using the enamel we tested carefully to see that it was free from acid or alkali, and also tested its insulating qualities against electricity, and we don't anticipate any trouble from electrolysis on the new line. We have had some trouble with the use of rubber gaskets in making joints, due, I presume, to the solubility of rubber in the presence of the hydro-carbons of oil gas. The benzol has a tendency to soften and destroy the rubber next to the pipe, to such an extent that the flanges at the joints become loosened and cause slight leaks. In order to prevent the gas from coming in contact with the rubber gaskets we apply a coat of orange shellac dissolved in alcohol to the V shaped space between the sleeve and the gasket and next to the pipe, and on one surface of the rubber gasket, so that there is no actual contact between the gas and rubber. The gas comes in contact with the coat of shellac, and we hope that this will prevent the disastrous effect of benzol on the rubber gaskets. This line was laid by Mr. W. R. Morgan, our able superintendent of distribution.

To show you how we have advanced in the laying of high pressure mains. This pipe line is not yet in use for conveying gas, on account of construction work now going on. This main has been under pressure, under 60 pounds pressure for over 30 days, and it has maintained a constant pressure at uniform temperatures both day and night.

Mr. Newbert: I would like to ask if soft lead has ever been tried in the gasket, in the place of rubber?

Mr. Jones: We were able to try a gasket on the Petaluma line, which is one and eight-tenths inches internal diameter, and sixteen and eight-tenths miles long. We found rubber gaskets would soften, and we were casting about for some other expedient, something that would answer the purpose and make the joints tight, and Mr. Weber, manager of the Petaluma plant, suggested the use of soft lead wire, in place of rubber gaskets. Under Mr. Weber's direction and entirely due to his ingenuity, that entire line was supplied with soft lead gaskets, and is tight so far as we know.

"Fire Insurance and Protection."

Mr. Britton: I am sorry Mr. Cantrell is not here. He was appointed some three or four years ago, as insurance agent for the Pacific Gas & Electric Company. His duties are to trace up the causes of fires and make recommendations as to how we can best prevent them. Our territory covers 30,000 square miles and has in it, all types and characters of buildings and structures, and he has made periodical visits to every station and every office, and if he has accomplished nothing else, from my observation as I followed in his tracks, he had drawn to our attention, the value of cleanliness on the part of the employe. He has caused offices to be cleaned out; he has caused walls to be whitewashed, broken windows to be replaced, and has caused the removal of inflammable articles to places where they would be least likely to catch fire. He has awakened a spirit in every employe of the company, looking toward cleanliness, and I can see a very marked improvement in the plants. And I sometimes think that I can trace, in the analysis of the weekly and monthly report that we get, a tendency toward economy, due to the greater interest taken in the care of the plant, instanced by this periodical inspection. His salary has been earned over and over again and many a disastrous fire which might have occurred has been prevented by his recommendations, and in that way he saved us thousands of dollars.

Mr. Leach: In regard to that Mr. President, I would like to say that a spontaneous combustion fire was created in this way. If it had been in yard where it occurred, we would probably have lost one of our large warehouses, but it occurred in the bin as a result of Mr. Cantrell's visit. Saturday afternoon as the men were cleaning up, the foreman of that department found some oily matter in one of the rooms and insisted upon having it put in the bin. Sunday evening the fire department was playing the hose on the bin.

I feel that this question of fires should be looked at entirely without prejudice. Very often the carelessness of property owners adjacent to our own property, scattered about the various cities, causes us more loss than the carelessness of our own employes, or any lack of fire appliance that we might have. In the larger cities the fire department are more or less of a political nature. A good many individuals are permitted to have gasoline lamps and gasoline stoves in their buildings and oil furnaces are not carefully looked after, all of which causes destructive fires; and if it is a large building it is more apt to have this trouble and these fires frequently result in a great loss to the gas and electric companies.

I think the time will come when the fire fighting will be done by a corporation, created and organized for that purpose, and that fire fighting is just as much of a business as gas and electric lighting is a business. I think some means should be taken, something should be started, that would create a public approval of putting all fire fighting in the State, under the entire supervision of the fire underwriters, and taken out of politics entirely.

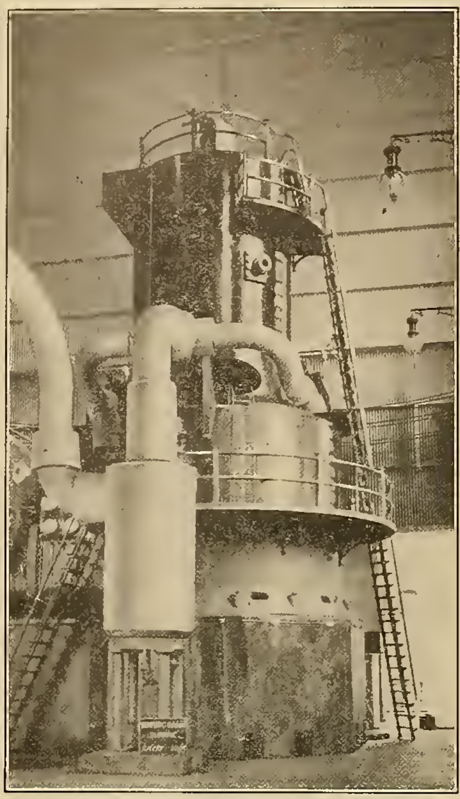
Mr. Schade: I would like to say that a friend of mine has gotten up a simple patent for handling gasoline, oil, or any combustible with water. About two weeks ago some parties got hold of it and organized a two-million dollar company, and refused to have any display made at this time. It is a most valuable thing for an oil man to own, and install. Instead of pumping oil with it, you pump water. It is absolutely fireproof; you can build a fire over it, under it, or around it, and it won't catch fire.

Mr. Jones: For the benefit of Mr. Schade I would like to say, that a device used for the same purpose as stated by him, has been in use by gas companies for the last twenty years.

Mr. Schade: I thank Mr. Jones very much. I know there have been in use such devices, but not like this one.

TURBO GENERATOR TESTS.

At the annual meeting of the American Society of Mechanical Engineers in New York City on December 7, 1910, two papers were presented dealing with tests of large steam turbine units operated under



9000 kw. Turbo-Generator at Oakland Plant of Pacific Gas & Electric Company.

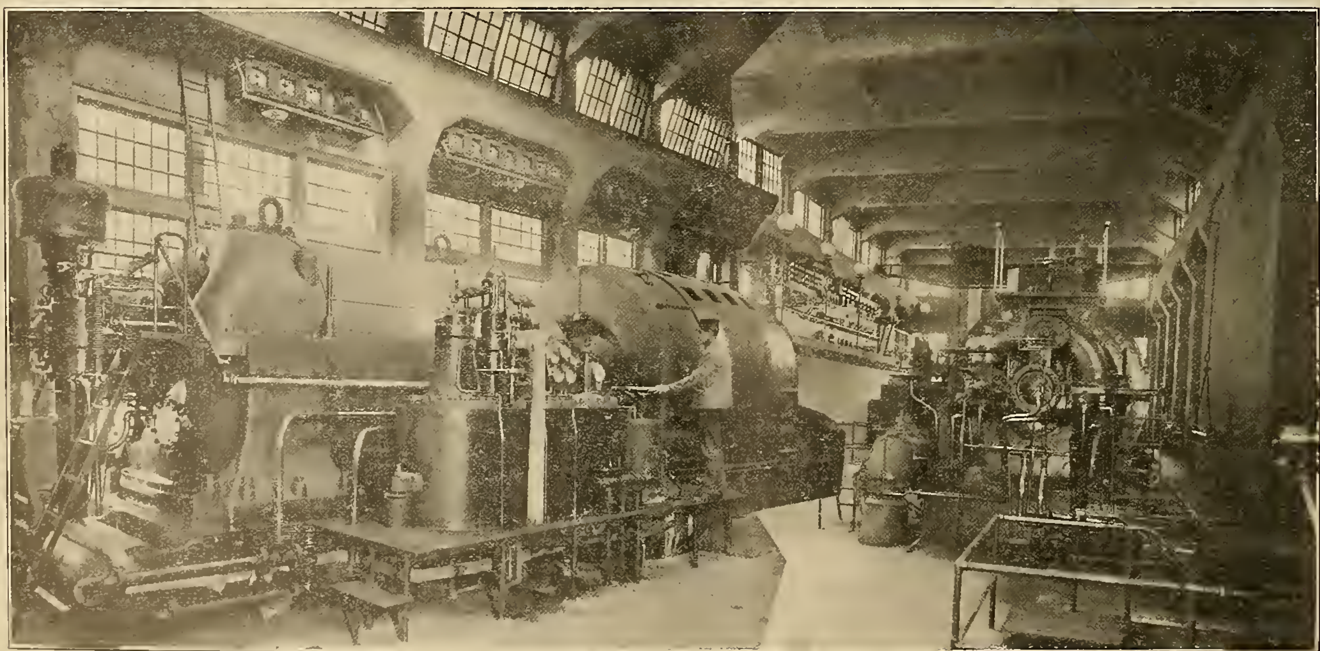
Pacific Coast conditions. H. Varney's paper considered the tests of the 9000 kw. Curtis vertical turbine in the Oakland plant of the Pacific Gas & Electric Company illustrated and described in this journal of March 5, 1910. S. L. Naphtaly's paper was concerned with tests of a 10,000 kw. Westinghouse-Parsons horizontal turbo-generator in the San Francisco plant of the City Electric Company, described in these columns on August 20, 1910.

In each case the tests were made under operating loads to verify the builders' guarantees. Both plants are oil-burning, supplying steam at 175 lb. gauge and equipped with super-heaters for 100 degrees superheat.

The Oakland turbine was subjected to two four-hour tests, under loads of 7000 kw. and 9000 kw. respectively. The final result for the 7000 kw. test was a steam consumption of 16.06 lb. per kw. hour without correction, or 15.82 lb. under the corrected conditions specified in the contract. Under the 9000 kw. load the uncorrected steam consumption was 15.95 lb. and the corrected 15.42 lb. per kilowatt hour. The corrected vacuum was 28 in. Steam was furnished by eight 754 h.p. McNaul water-tube boilers. The condenser and vacuum pumps were of Worthington make.

Seven tests were made in the City Electric Company's turbine, varying from 1.5 to 4 hours in duration. Correcting to 175 lb. pressure and 100 degrees superheat, 28 in. vacuum, the steam consumption in lb. per kw. hour was 14.11 for 7972 kw. load, 13.88 for 8563 kw., 14.04 for 8198 kw., 13.88 for 9173 kw., 15.21 for 5333 kw., 1407 for 8148 kw. and 15.24 for 5401 kw., the last two being with a low vacuum (26.16 lb) to determine the effect of variation in vacuum on this machine. Steam is supplied by Babcock and Wilcox boilers. Auxiliary apparatus included Wheeler condensers and pumps.

Electrical dispersion of fogs is being studied by Sir Oliver Lodge, particularly with reference to sea-ports. He suggests that the British Government should allot one-half million dollars annually to universities carrying on these experiments.



10,000 kw. Turbo-Generator Set at San Francisco Plant City Electric Company.

VALUATION OF PUBLIC UTILITIES.

The valuation of public service corporation property was recently discussed by H. E. Riggs at a meeting of the American Society of Civil Engineers Mr. Riggs stated that the industrial and economic development of the past two decades has opened many new lines of special work in the profession of engineering, none of which is more difficult and complicated or of greater ultimate value to the public at large than that of the appraisal or valuation of the property owned and operated by public service corporations; and none of the fields of engineering specialization requires greater care or calls for more skill, experience, integrity, or sound judgment.

Valuations may be required either as a matter of public interest, such as to give information on the taxation of corporations, rate regulation, limitation of capitalization, or for franchise purposes; or it may be a matter of corporation necessity or expediency.

A valuation, regardless of the purpose for which made, should be such as to secure a "fair value" of the property under consideration. Appraisers will encounter, among other difficulties, the fact that human selfishness is a dominant quality, and that attempts are sometimes made to influence a valuation from selfish motives; also that human machines are not exact duplicates, and that allowance must be made for a large measure of error, on account of the personal equation of the men engaged on the work, as individual errors of judgment are frequent on any work of magnitude. This personal element must be corrected by uniformity of method, by constant checking, and, as far as possible, by subordination of personality to system.

All properties being appraised should be considered as operating properties. One which is dead, inert, and not in use, cannot be considered as coming under such a discussion as this, and such properties are not treated in this paper. The term "going concern" is not used in connection with the physical property, any element of value implied by the term, over and above the "overhead charges," being treated as intangible or non-physical element of value.

Explanation of Terms.

In order that there may be no doubt as to the exact meaning of the terms used throughout this paper, a few definitions or explanations are submitted:

Appraisal, or Valuation.—These words are used interchangeably, and refer to the engineering work of determining the present worth of both physical and intangible properties of corporations.

Cost of Reproduction.—This expression refers to the estimate of cost of reproducing the physical properties as they exist on the date of the appraisal, all elements entering into the cost being considered as new and not affected by the elements of depreciation or obsolescence.

Cost, or Original Cost.—These terms refer to the actual amount of money paid for the property, either when it was originally constructed, or in its condition at the time of appraisal, the latter case being the original cost plus the cost of additions and betterments, less abandoned, replaced, or worn-out property. This figure ought to be represented by the "book cost," but it is not often that "book cost" and "actual cost" are the same.

Present Value, or Present Physical Value.—These terms are used in describing the physical property as reproduced after it is affected by all elements of depreciation or appreciation. The use of the word "value" in this expression is unfortunate, as it may lead to some confusion. It must be kept clearly in mind that, where this term is used, it refers only to physical property as depreciated, and is in no case intended to refer to the final or "fair" value of the property.

Non-physical, or Intangible, Value.—These terms are used to represent those elements, entering into the final worth of the property as a business concern, which arise out of the operation of the property and are not attachable to the physical property.

What is "value?" In defining the exact meaning of this term, as applied to the property of a public service corporation, a number of elements must be taken into account. Standard authorities give many definitions of the term. As a definition of that estimate of worth which an engineering commission should report as the result of a complete appraisal, the writer submits the following:

The value of a property is its estimated worth at a given time, measured in money, taking into account all the elements which add to its usefulness or desirability as a business or profit-earning proposition.

There are two classes of elements entering into the final value:

(1) The "Physical" Property Element of Value.—This consists of those things which are visible and tangible, which are capable of being inventoried, their cost of reproduction determined, and their depreciation measured. The property is considered as an operating entity, and, being so considered, carries as part of the physical value, those costs and charges which are an inseparable part of the cost of construction but do not appear in the inventory of the completed property.

(2) The "Non-Physical" or "Intangible" Elements of Value.—These are those things which, added to or taken from the worth of the physical property, make up the value, and include whatever accrues to the property by reason of its operation, or by reason of grants, contract rights, competition, or location, which at the time of appraisal affect favorably or unfavorably the worth of the property.

The physical property is that which enables the corporation to do business. Without physical property it could not produce the commodity which it sells. The amount of money actually invested in acquiring that physical property represents the measure of capital on which it is morally entitled to earn interest and profit; and, in the stage of promoting and financing the enterprise, all hope of earnings is based on the amount of money required to construct the property. These considerations lead the writer to contend that the true method of valuing a corporate property is first to determine the cost of reproduction of the property and its depreciation, and modify this figure by any applicable positive or negative non-physical elements of value.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. Strong, President
A. H. Halloran, Vice President and Managing Editor
C. L. Cory, Secretary.

DIRECTORS
R. J. Davis A. M. Hunt A. H. Halloran C. L. Cory E. B. Strong
604 Mission Street, San Francisco

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. Manfred, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas." August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

Public Satisfaction Corporations

The good-will of the people is seldom reckoned as an asset in appraising a public utility, though its absence is a recognized liability. It is perhaps the most intangible of all those non-physical values accruing from the possession of franchises, monopoly, or demand for service. Though at one time the most easily obtained, it has frequently been so carelessly disregarded that it is now as hard to regain as is the spurned love of a woman. Many managers have already awakened to this fact and there were few meetings of electric light and power associations this year at which this question was not discussed. Many of their papers on cultivating friendly relations with the public have been published in these columns, but, judging from personal experience, their spirit and intent has not been transmitted to the rank and file who come in most intimate contact with the people that the corporation is endeavoring to serve.

Every employee of every public service company should realize that he is the personal representative of his company, and often the only one by whom his employer is judged. His incivility and lack of accommodation prejudices patrons and depreciates public estimation. Nothing is more irritating than the pompous assumption of superiority of a petty government clerk who forgets that he is being paid by the people whom he displeases. The same spirit seemingly pervades many workers for these quasi-public utility companies whose prosperity is even more vitally dependent upon public favor. If all employees would unite in trying to satisfy the public, their company, instead of being a public dissatisfaction whose stock is almost unsalable, would become a public satisfaction corporation whose position would be almost unassailable.

To satisfy the people that the corporations are giving good service at reasonable rates is the prime object of the public service commissions that have been established in Massachusetts, New York, Wisconsin, New Jersey, Vermont, Connecticut and Maryland. In these states regulation is proving to be good for the people and better for the corporation because it establishes a friendly feeling of confidence. Other states will soon follow suit. The movement is as gradual but irresistible as that of a glacier. In states where the corporations have been rapacious the laws will be radical, but where they have been conciliatory the legislation will be conservative.

It consequently behooves every corporation to seek the public favor. Why talk of cultivating friendly relations when it is possible to be a friendly relation to every consumer? An occasional "Dutch uncle" talk from the manager of the lighting company will convince his fellow-townsmen that he is their friend and that they should become his. The power and influence of a corporation in the capacity of a big brother can help every community. If this friendly feeling be not established, there is a further possibility that the relations will be reversed, and that a paternal government will assume not only regulation but also operation.

PERSONALS.

Rudolph W. Van Norden is doing some engineering work in Eldorado county, California.

L. Work, an electrical supply dealer of Monterey, was a San Francisco visitor last week.

F. G. Baum, of F. G. Baum & Co., electrical engineers, has returned from Santa Barbara to San Francisco.

A. W. Smith and A. F. Smith of the Sacramento Valley Power Company, visited San Francisco this week.

Leon Bly, secretary of the Sierra Electric Power Company of Red Bluff, was at San Francisco last week.

R. M. Morton, engineer of the Highways Commission of San Joaquin county, spent last Monday at San Francisco.

W. S. Heger, the California manager of the Allis-Chalmers Company, spent the past week at his Los Angeles office.

Thomas Mirk, of Hunt, Mirk & Co., returned to San Francisco last Monday from a business trip to San Diego.

H. R. Noack, manager of Pierson, Roeding & Co., recently returned to San Francisco after a business trip through Oregon.

J. L. Stannard and A. L. Richardson have opened offices as civil and hydraulic engineers in the Henry Building, Portland, Ore.

H. W. Jacobs of Santa Rosa, and D. W. Thomas of Petaluma, were among the electrical supply dealers at San Francisco last week.

H. L. Jackman, manager of the Humboldt Gas & Electric Company of Eureka, was a San Francisco visitor during the past week.

C. W. Curtis has been appointed general foreman of the Los Angeles & Redondo Railway, Los Angeles, Cal., in charge of the power department.

C. P. Baird, manager of the Lompoc Light & Power Company, of Lompoc, arrived at San Francisco last Saturday, accompanied by his bride.

L. O. Lieber has resigned as electrical engineer of the Los Angeles & Redondo Railway, Los Angeles, Cal., and the position has been abolished.

Chas. Derleth has been elected president and James H. Wise vice-president of the San Francisco branch of the American Society of Civil Engineers.

John M. Gardiner, who is interested in electric power and railway plants in Southern California, was at San Francisco from Los Angeles during the past week.

Samuel Taylor, manager of the Electric Railway & Manufacturers' Supply Company, has returned to San Francisco after making an extensive Eastern trip.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company, of Chicago, spent the past week on a tour of the Pacific Northwest.

Delos A. Chappell of the Hydroelectric Company of Bodie, returned to the power site last week, after spending some time at San Francisco in conference with his principals.

C. W. Burkett, general superintendent of plant with headquarters at the San Francisco office of the Pacific Telephone & Telegraph Company, has been at New York for several weeks past.

L. L. Johnson, formerly gas engineer for the electrical department of the Southern Pacific Co. at San Francisco, has opened an office as consulting engineer on gas, power and fuel plants at Indianapolis, Ind.

Robert Howes has completed the installation of the Fraser Valley line of the British Columbia Electric Railway Company and has opened offices as consulting engineer in the American Bank Building, Seattle.

Leon M. Hall, the former chief engineer of the Comstock Pumping Association, was recently presented with an elegant gold watch as a token of the esteem in which he is held by the employees of the mines at Virginia City.

C. E. Groesbeck, Pacific Coast manager of the H. M. Byllesby Company, with headquarters at Portland, arrived at San Francisco last Monday on business connected with the taking over of electric power plants purchased by the Byllesby interests.

E. G. Dewald, with the Pelton Water Wheel Company, has returned to the San Francisco office from Big Bend, where he started a Pelton oil-pressure governor, which had just been installed to regulate the large water-wheels of the Great Western Power Company's big transmission plant.

H. Y. Liang, a prominent Oriental engineer, has been spending several weeks at San Francisco getting important data for use in connection with industrial enterprises for the Chinese government. He recently visited the oil fields of California. Liang has made his local headquarters with Smith, Emery & Co.

TRADE NOTES.

The General Electric Company has sold to Cady & Bunnell, of Susanville, a 150 kw., 6600-v., 600 r.p.m water wheel driven generator, together with a 5-kw. exciter set and a switchboard.

The Northwest Oil Burner & Equipment Company has been organized by W. F. Ross and A. G. Starrock with offices in the Couch Building, Portland, Ore. They are the sole agents for the Hammel Oil Burner Company of Los Angeles.

MEETING NOTICES.

The Seattle Section of the American Institute of Electrical Engineers at their meeting on December 17th, listened to a paper on the subject of "Continuity of Service," by Magnus T. Crawford of the Seattle-Tacoma Power Company.

The Los Angeles Section of the American Institute of Electrical Engineers will meet at Blanchard Hall, 231 South Broadway, at 8 p. m., on December 29th. Prof. R. W. Sorensen will present a paper on "Transformers and Their Selection.'

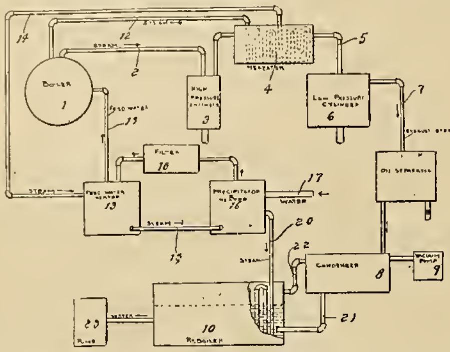
The Engineers' Club of Oregon was organized on December 7 at Portland. George L. Bliven was elected chairman and A. D. Monteith secretary. A strong membership committee was organized and vigorous efforts will be made to induce all engineers to join.

The San Francisco Section of the American Institute of Electrical Engineers will not meet on December 30th, on account of the probable absence of many members during the Christmas and New Year period. Prof. Ryan will discuss Atmospheric Electricity at the meeting of January 28, 1911.

The annual convention of the American Institute of Architects will be held at San Francisco, January 17-19, 1911. Papers to be read include "The Development of Architecture on the Pacific Coast," "The Rehabilitation of the City of San Francisco," "The Aesthetic Problems of and what the Coast has Accomplished in City Planning," "The Salient Points of the Architecture of the Northern Pacific Coast," "History and Present Status of the California Missions."

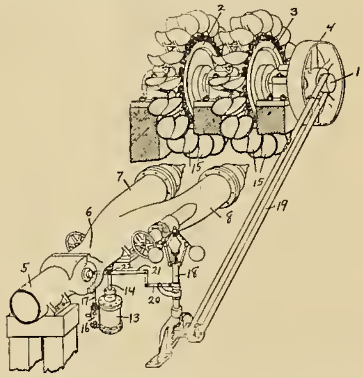
PATENTS

978,279. **Distillation System for Ice Plants.** Arthur Faget, San Francisco, Cal., assignor to Pacific Engineering Company, San Francisco, Cal. In a water distillation system, a steam boiler, a steam power plant, steam connections from



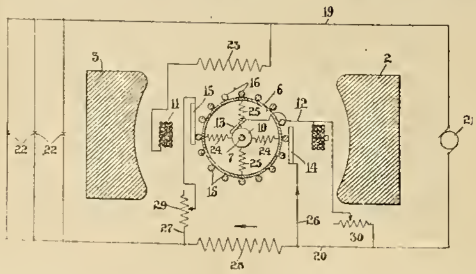
the boiler whereby the steam used in the power plant may be reheated during its passage therethrough, a feed-water heater and steam connections from the reheater to the feed water heater, whereby the live steam passing through the reheater will heat the feed water nearly to that of the boiler, as set forth.

987,335. **Water-Wheel.** Arnold Pfau, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. The combination with a shaft, of a plurality of water jet actuatable wheels theron, a pipe for supplying water to said wheels, a branched nozzle hinged to said pipe at a single connection with the hinge axis at an angle to the pipe conduit at the



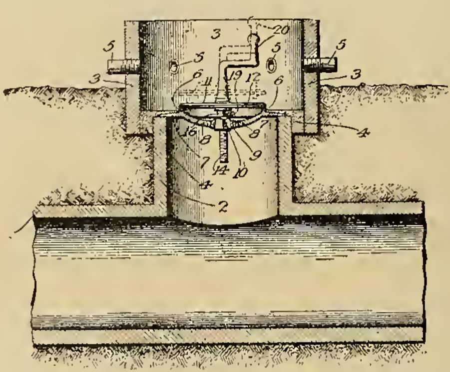
single hinge connection, the number of branches of said nozzle corresponding to the number of wheels upon said shaft, each of said branches being provided with a valve for controlling the flow of water therethrough, a governor responsive to the changes of speed of said shaft, and a single regulating means controlled by said governor for raising and lowering said branched nozzle.

978,518. **Electrical Measuring Instrument.** Thomas W. Varley, New York, N. Y., assignor to Westinghouse Electric



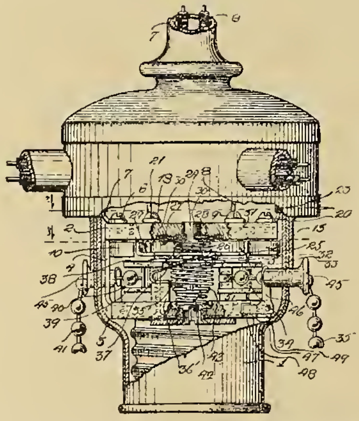
and Manufacturing Company. In an apparatus of the character described, a substantially constant magnet, a coil adapted to shift or distort the field caused by said magnet, an armature in said field, adapted to respond to the shifting or distorting thereof, and having more than one connection to one side of the main circuit, a resistance in said main circuit between said connections, an adjustable resistance in one of said connections, a resistance across the armature adapted to collect current from different points thereof, and means for taking off current from said last named resistance at a point intermediate the ends thereof.

978,567. **Irrigation-Valve.** James M. Eads and Arthur S. Bent, Los Angeles, Cal. An irrigation valve comprising a ring forming a valve seat and having a flange cast integrally therewith, a downwardly bowed yoke extending across the ring and being cast integrally therewith, said yoke having a square, tapered orifice formed therein, a brass, square, tapered nut in the orifice in the yoke, the small end of the nut being



headed over to secure it in position, an adjusting screw in said nut, said screw having a shoulder, a round portion below the shoulder and a square portion below said round portion, a valve disk below said shoulder, a gasket below the valve disk, said valve disk and said gasket being on said round portion of the screw, a square sleeve with a round flange below the gasket and supporting the same and being mounted on said squared portion of the adjusting screw, a set screw securing said sleeve to the squared portion, and a crank formed on the upper end of the screw.

978,805. **Switch Mechanism.** Charles D. Weimer, Los Angeles, Cal. A switch mechanism comprising a plurality of stationary contacts, a movable contact, means to move said movable contact in engagement with said stationary contacts, means to hold movable contact in engagement with said



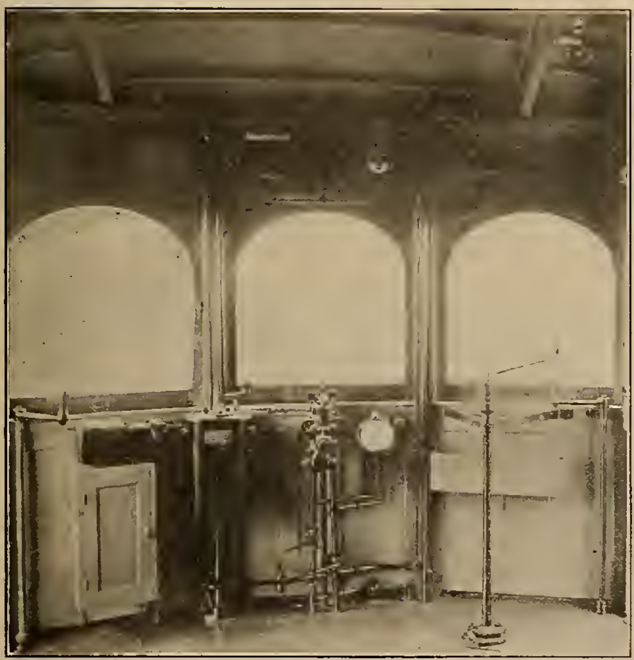
stationary contacts, and a means to disengage said moving means and said holding means from said movable contact to leave said movable contact free to return to normal position and out of engagement with said stationary contacts

INDUSTRIAL

NEW MOTOR CAR EQUIPMENT FOR PEORIA RAILWAY TERMINAL COMPANY.

The Peoria Railway Terminal Company has recently added five new, double truck passenger cars to its rolling stock. This company operates a standard gauge interurban electric line, connecting Peoria, Bartonville, South Bartonville, Hollis and Pekin. The new cars which are 57 feet over-all and which when fully loaded weigh approximately forty tons, are of the single end type. The car bodies complete with truck were built by the McGuire, Cummins Manufacturing Company. The trucks are equipped with 36 in. wheels mounted on 6 in. axles with 7 in. gear fit arranged for a gear ratio of 18.69. It is expected that when operating on normal schedule the single trip will include six stops in the interurban districts and an average of six or seven in the 2.8 miles of city running.

The new car is fitted with a quadruple equipment consisting of four No 304-A interpole railway motors, each motor having a nominal rating of 75 h.p. at 500 volts or 90 h.p. at



Motorman's Station in New Motor Car.

600 volts. All the important characteristics which through long tests of service have won favorable recognition whereever they have been introduced are embodied in these motors—split frames, separate oil gauging reservoirs, waste packed bearings, detachable bearing housing with provision for holding the armature in normal position while lower half of frame is dropped for examination, strap wound coils for field and armature, two-point gear case suspension and superior workmanship throughout.

The well known Westinghouse hand-operated unit switch control is used on each car. The line switches and each unit of the control switch is actuated by air under pressure of 70 lb. per square inch. The only current flowing through the master controller is the small amount required to energize the electro-magnetically operated needle valve which admits air to the air cylinders of the switch. The switch jaws are brought together with a positiveness and intimacy of contact impossible to attain with any solenoid operated contactors in which the contact pressure is of necessity a function of the line voltage. With the electro-pneumatic control a uniform reliability of operation is assured independent of fluctuations of line voltage. It can be used without risk of injury under conditions where the excessive current resulting from low line voltage would result in seriously burning or welding the contacts of any other type of switch. Both the motors and control were made by the Westinghouse Electric & Manufacturing Company.

A CABLE FORMING BOARD.

In order to make it easier for the electrical contractor who has had no experience installing inter-communicating telephones, to install their inter-phones in an up-to-date manner, the Western Electric Company is furnishing full sized diagrams of cable forming boards. These diagrams enable the contractor to make cable forming boards for every variety of inter-phone sets.

The advantage of forming the cable is apparent to all those experienced in telephone work, but until recently its importance was not realized by the electrical contractor. Experience has shown that the best plan to follow in cabling an interior telephone system is to form the cable at each telephone set so that each conductor or pair of conductors

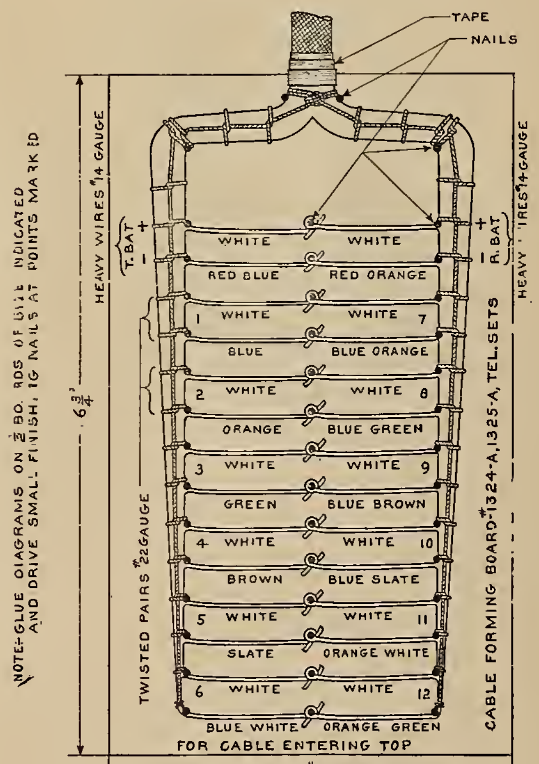


Fig. 1. Diagram of Cable Forming Board.

will be separated from the rest and sewed permanently into their respective places by the means of extra stout twine made especially for the purpose. In this way every conductor is brought out of the cable at its proper place and there can be no disarrangement of the conductors due to later handling. This reduces to a minimum the likelihood of the conductors being crossed.

Fig. 1 shows a cut of a diagram; this diagram, as furnished, is first glued upon a board about one-half an inch thick and then the board is sawed along the edges of the

diagram. This makes the board of the proper size for the different types of telephones noted on the diagram. At the points marked, small nails are driven into the board and wires are formed around the nails and sewed into place as indicated on the diagram.

A completely formed cable, sewed as it should be, is illustrated in Fig. 2. The proper twine used for the purpose is twelve strand linen, as this provides sufficient strength for allowing the stitches to be drawn up extremely tight without the chance of breaking the twine. When the cable is completed, it is lifted off the forming board and is then of the proper size, so that the conductors come out of the proper places to attach directly to the correct terminals in the telephone sets.

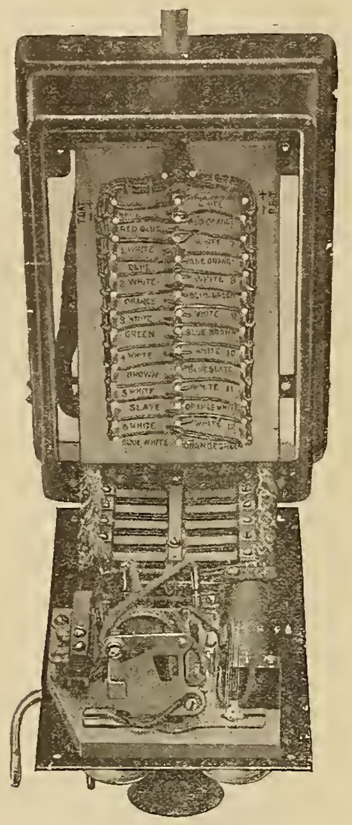


Fig. 2. Cable Entering Top of Set Has Been Formed.

The use of these forming boards insures the continued satisfactory operation of an inter-phone system, as there is little chance of the apparatus itself getting out of order when properly installed.

NEW CATALOGUES.

Bulletin 1501 describing Allis-Chalmers Reliance Belted Corliss Engines has been reprinted by the Allis-Chalmers Co.

Automatic voltage regulators for direct current generators are described in bulletin No. 4602-B from the General Electric Company.

The General Electric Company has recently issued a new edition of its bulletin on Watthour Meters for Switchboard Service, the number of which is 4662-A.

The Electric Controller and Manufacturing Company has issued an interesting booklet of facts about lighting magnets; graphically illustrating some superior constructional details of E. C. & M. K. magnets.

Bulletin No. 8 from the Benjamin Electric Manufacturing Company, is concerned with Special Fixtures and Accessories for Mazda-Tungsten Lamps. These include reflector sockets, street lighting fixtures and multiple and series sockets for large base lamps.

Bulletin No. 4794 was recently issued by the General Electric Company, describing the 1200-volt lines of the Milwaukee Electric Railway and Light Company. This is a reprint of an article which appeared in the Electric Railway Journal.

The Westinghouse Diary for 1911, a handsome red-leather pocket book, contains much new data on electrical machinery, steam turbines and incandescent lamps not published in former issues of this valuable annual. Considerable irrelevant matter has also been omitted.

The Standard Underground Cable Company have issued a valuable booklet on Colonial Copper Clad Wire which consists of a steel core to which a copper covering is firmly welded, thus giving a conductor of low resistance, great tensile strength and elasticity and an exposed service not affected by the weather, all at a comparatively low cost.

Bulletin No. 4786, just issued by the General Electric Company under the title of "Signals, Auxiliary Apparatus and Materials," describes a simple and reliable motor signal having a signal mechanism suitable for either two or three position operation in either the upper or the lower quadrant. This standard mechanism is also applicable to either top or bottom mast operation with but slight modifications. The bulletin contains nearly 90 pages of information, including exterior and interior views of the signal and a detailed description of the signal and apparatus used in connection with its operation.

"California for the Tourist" is the subject of a beautiful book just published by the Southern Pacific. By picture and text it portrays the charm of this land of sunshine by summit, sea and shore. The front cover shows a native daughter culling golden California poppies close to the blue waters of the Santa Barbara channel overlooked by the old Spanish mission of that name, the back cover shows a Sierra lake and snow covered mountain viewed from an observation car—all in the most exquisite colors. Localities illustrated include San Francisco and its environs, the Klamath country and Crater Lake, the Shasta region, Lake Tahoe, Yosemite Valley, the Kings and Kern rivers, Monterey Bay, Santa Barbara, Los Angeles and San Diego, good maps of each district being provided.

The General Electric Company has recently issued Bulletin No. 4790, on Electric Mine Locomotives, which supersedes its previous bulletin on the same subject. This bulletin illustrates and describes in considerable detail two and three-motor mine locomotives of various capacities, arranged to operate either singly or in tandem. The bulletin describes also the company's gathering locomotive, which consists of any one of its standard locomotives equipped with a motor-operated reel, to which is attached flexible heavy insulated cable. These gathering locomotives can, therefore, be operated for some distance beyond the terminal of the trolley wire by merely slipping a hook fastened to one end of the cable over the trolley wire. The reel operates automatically, and the locomotive is operated in the same manner as when the trolley is used. This publication also describes the various devices, such as controllers, fuse blocks, headlights, etc., with which the locomotives are equipped.

PORTLAND OFFICE OF PIERSON, ROEDING & CO.

Pierson, Roeding & Co. have established offices at 707 Spalding Bldg., Portland, Ore., under the management of S. H. Lanyon. Offices are also maintained in the Coleman Bldg., Seattle; the Monadnock Bldg., San Francisco, and the Pacific Electric Bldg., Los Angeles. Pierson, Roeding & Co. are Pacific Coast representatives of the Electric Storage Battery Co., Lombard Governor Co., Locke Insulator Mfg. Co., Aluminum Company of America, Ohio Brass Co., J. G. Brill Co., Fibre Conduit Co., R. D. Nuttall Co., and Bridgport Brass Co.

NEWS NOTES

NEW INCORPORATIONS.

SAN FRANCISCO, CAL.—The Sierra Incandescent Lamp Company has been incorporated by E. H. Fosdick, W. H. Taylor and C. A. Barhydt with a capital stock of $50,000.

SAN FRANCISCO, CAL.—The Sacramento Valley Power Company has been incorporated by A. Armstrong, H. E. Willis, D. Righetti, Grant Cordrey, F. V. Vollmer, L. Sutter and E. Maytorena with a capital stock of $2,000,000.

JACKSON, CAL.—The Amador Mines, Power & Water Company has been incorporated here. The new company will soon build a storage reservoir covering 150 acres of land near Pine Grove, ten miles from here, the capacity of which will be 4,000,000,000 gallons.

SAN FRANCISCO, CAL.—The Pine Mountain Water Company has been incorporated here. Its authorized capital is $3,000,000, the directors being Duncan McDuffie, C. L. Cory, W. T. Vincent, Jr., and W. C. Crud, all of Berkeley, and C. G. Dall of San Francisco. The articles authorize the concern to sell water for any purpose in any part of the State.

FRESNO, CAL.—The Vineland Telephone Company has been incorporated with $25,000 capital stock in 1000 shares and with J. C. Ashlin, Willfred Baker, R. S. Elliott, P. H. Carlsgard and N. O. P. Syonground as the directors. Subscribed capital stock is $1725 by 59 subscribers. The corporation will erect a telephone line for the accommodation of farmers in the Kerman district from the town to and beyond the river. The main line will cover 6½ miles from the southeast corner of Section 12, 14-18 in a northerly direction to the northeast corner of SE¼ of Section 12, 13-17. It will have eight branch lines in as many directions covering ten miles more to nearby ranch subscribers.

FINANCIAL.

MONROVIA, Cal.—The City Trustees will hold a special meeting to receive bids on $120,000 sewer and $50,000 water bonds. The bonds will not be formally sold however until later.

PORTLAND, CAL.—The Portland Railway, Light & Power Company will increase its capital stock from $15,000,000 to $25,000,000 in order that much needed extensions throughout the city may be made.

ESCONDIDO, CAL.—At a directors' meeting of the Escondido Mutual Water Company an assessment of 5 cents per share was levied in order to continue the work of replacing wooden flumes on the San Luis Rey river with a tunnel and stone and cement ditches. The water pipes will be extended into the tract of the Escondido Development Company, in South Escondido.

ALTURAS, CAL.—The Trustees have issued a call for a bond election to be held in January, 1911, to act on a proposition to issue $33,000 in bonds for waterworks and $2000 to raise funds for a fire equipment, making an issue of $35,000. It is proposed to have the bonds for water works extend over a period of 40 years, to be paid in equal annual payments of $1000 each, with interest at 5 per cent per annum.

LOS ANGELES, CAL.—The Southern California Gas Company has issued $10,000,000 in first mortgage 40-year gold bonds. The Trust Company of America is named as trustee. Several months ago, the gas company acquired the holdings of the Domestic Gas Company and is issuing the mortgage to redeem certain bonds issued by the original company. The remainder of the money raised will be expended in completing the Redondo plant and extending the gas mains to San Bernardino.

ILLUMINATION.

PASADENA, CAL.—Preparations are being made to increase the capacity of the Pasadena municipal light plant.

LEWISTON, ORE.—The City Council has passed in amended form, a franchise to E. H. Libby, for 25 years, to carry on a light, heating and power business in the city of Lewiston.

FRESNO, CAL.—Hereafter the office of the purchasing agent for the San Joaquin Light & Power Company will be in Fresno instead of Los Angeles. J. H. Newlin will occupy the office. As heretofore the company will invite competitive bids for all bid orders.

CHEHALIS, WASH.—Heller, Sinclair & Anderson, who are interested in the Twin City Light & Traction Company in a directors' meeting in this city authorized the expenditure of $100,000 for improvements of permanent natures. A large power house will be constructed.

OROVILLE, CAL.—During the year of 1911 the Oro Water, Light & Power Company will spend $70,000 in improvements upon its local distributing system of water, electricity and gas in this city. The announcement was made by Manager R. L. Van der Naillen.

MERIDIAN, CAL.—Engineers in the employ of the Pacific Gas & Electric Company are busy here making a survey of the streets. The company is preparing to extend its power line from here to Colusa. Power will also be available for the reclamation districts between here and Colusa.

CANYON CITY, ORE.—The Eastern Oregon Light & Power Company is making arrangements to install a power plant at Lagoon lake and furnish power and light for the John Day valley. W. C. Parrish of Baker City, who has been here some time making arrangements, will in a short time be in a position to enter into contracts for light and fuel.

ELMA, WASH.—The Olympia Railroad & Power Company of this place announces that New York capitalists are coming here within a short time to look over the company's holdings and will buy same or finance the company in its development of power and transportation plans, which include the harnessing of water powers and furnishing of light and power for all the cities of southwest Washington.

JACKSON, CAL.—The Board of Supervisors has passed an ordinance granting to John L. Henry a franchise to erect and maintain along the public highways and alleys, in Township No. 3, in Amador county, poles and other superstructures upon which to suspend wires and other appliances for the conducting of electric current for telephone and telegraph and for all the purposes to which the same may be adapted.

MERCED, CAL.—Negotiations are now under way between the San Joaquin Light & Power Corporation and the business men of the city looking toward the installation of at least fifty electroliers for street lighting. R. L. Bearden, representative of the company, is at present in the city and has about completed a canvass of the business houses. He has met with success and will send for a representative of the company that does the work of installation of the electroliers.

LOS ANGELES, CAL.—The Domestic Gas Company, lately reincorporated as the Southern California Gas Company, a subsidiary of the Huntington Pacific Light & Power Corporation, has completed its purchase of the City Gas Company by paying to the officials of that concern $1,338,437. The transaction was handled through the banking-house of N. W. Halsey & Company, of San Francisco and New York, and the payment, in the form of a check, was deposited in San Francisco. The money will go to sixty stockholders, all residents of this city. J. F. Sartori, president of the Security Savings Bank, was one of the organizers and head of the selling company, and Captain Randolph H. Miller was a factor in its formation three years ago. When the City Company began to expand, the Huntington corporation, which plans to supply gas to practically all of Southern California, opened negotiations for its absorption and paid the management its own price. The stockholders made an enormous profit on their investments.

TRANSMISSION.

VALLEJO, CAL.—Contractor E. D. Crowley, of San Francisco is preparing to erect a new central power station at Mare Island yard early in January.

PASCO, WASH.—Plans are being drawn in the Portland office of the Pacific Power & Light Company for the largest switching stations in the Northwest. According to present estimate the building will be 200x80.

SAN LUIS OBISPO, CAL.—Plans are being prepared for the construction of an electric railway from this city to San Simeon, and from Cayucos to Paso Robles. A. M. Bianchi of Cayucos and Jas. E. McFee are interested.

TWIN FALLS, IDAHO.—Governor Brady, who controls practically all the stock of the Idaho Consolidated Power Company has announced that $30,000 additional horsepower is to be developed at American Falls during the coming year by the building of a new power house.

SPOKANE, WASH.—Ed. Donlan of Missoula, Mont., president of the Northwestern Development Company, has announced that the construction work on the dam and power station at Thompson Falls, Mont., will start early in spring. The contemplated improvements will cost $1,800,000 and will develop 30,000 horsepower.

RICHLAND, WASH.—Negotiations have about been completed between the Lower Yakima Irrigation Company and the Pacific Light & Power Company for the establishment of a power transmission line to connect with the high tension line of the latter company to furnish power for operating the two pumping plants of the irrigation company.

PORTLAND, ORE.—The Mount Hood Railway & Power Company has purchased a tract of land on the Willamette river for a site for its first auxiliary steam power plant. The contract has been let to Chas. C. Moore & Co. of San Francisco for the erection of the plant, the project to be completed within four months.

LIBBY, MONT.—The Libby Water Works, Electric Light & Power Company has secured a franchise for construction of telephone lines and it is reported work will be commenced in the spring. The company intends building toll lines into the adjacent towns. An electric light system will be installed at the same time. The Barnum Engineering Company of Great Falls, Mont., has charge of the work.

PARKER, ARIZ.—For the purpose of supplying and developing electrical power, to be used for pumping and lighting, plans are being made for the installation of a Price-Current Motor on the Colorado river at a point near Headgate Rock. W. H. Taggart, secretary of the Pacific Current Motor Company, of Los Angeles, was in this city securing data and will return in about a week prepared to enter into arrangements with holders of land for installation of a plant here.

WILLOWS, CAL.—A representative of the Northern California Power Company has made a protest to the Supervisors against the Shasta Power Company entering this county and especially against the latter company placing its pole line on the same side of the road as the line of the Northern company. The Supervisors informed the protestant that his company has encroached on the roadway eight feet with its pole line and had been ordered to remove these poles several years ago but had failed to do so. He was told that his company must take immediate action in obeying the orders of the Supervisors. The franchise for the Shasta Power Company is now being advertised.

SAN JACINTO, CAL.—A party of engineers has arrived here for the purpose of making final surveys in connection with power enterprises of Ramona Power Company, in the San Jacinto mountains. A reservoir site has been purchased of Angelo Domenigoni below Idyllwild. The company obtains rights for power purposes to practically all water in North Fork, Strawberry Creek and South Fork. The waters of these streams will be piped from a point as high up the canyons as possible in order to obtain a maximum drop down to a power house to be located in San Jacinto canyon near the foot of the mountain. After passing through the power house the waters will be returned to the natural sources.

WILLOWS, CAL.—Early in the coming year the Northern California Power Company which already has an electric power line reaching to this place, will begin the construction of a new line 10 miles long that will be supported on 50-foot reinforced concrete poles and will cost $200,000. It will run from the company's new power-house at Coleman, designed by Rudolph W. Van Norden, on Battle creek, Shasta county, through Red Bluff and Corning and to the head works of the Sacramento Valley Irrigation Company's canal system, two miles north of Hamilton City, where the 8000-h.p. current will be delivered to the pumping plant that will lift the water from the Sacramento river into the canal. The line will then come on to Willows, ending here for the present. Later it is to be extended to San Francisco Bay.

TRANSPORTATION.

PRINEVILLE, ORE.—A project is now on foot to build an electric line from here to Redmond by the Crook County Water, Light & Power Company.

SAN FRANCISCO, CAL.—Alleging that the United Railroads is using a patent car fender without license from the patentee, Ira P. Clark, of Decatur, Ill., asks for $24,000 damages in a complaint filed yesterday in the U. S. Circuit Court.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company proposes to build connecting lines so as to extend its K street line from Fifteenth to Twenty-first street, and to extend its Twenty-first street line north from Twenty-first and P to K street, to connect with the proposed K street extension.

VANCOUVER, B. C.—Messrs. C. S. Gzowski, C. H. Allen, Walter Gravely et al., are financing a scheme for improvements on Grouse mountain. Several miles of electric railway, costing $38,000 a mile, will be constructed on the slope of the mountain. A charter has been obtained and construction work will start in the spring.

MARTINEZ, CAL.—Work on the Oakland & Antioch Railway is progressing rapidly from Bay Point to Concord and it is the plan of the principals of the road to run the first cars from Bay Point to Walnut Creek on New Year's Eve. The rails have laid to within three miles of Concord, and the

right of way along the entire line has been graded. The work on the sub-station near Concord has been completed and the transformers installed.

PORTLAND, ORE.—Franchises for the entrance of the Mt. Hood Railway into Portland will be asked of the City Council at an early meeting, according to plans now being formulated by R. C. Gillis of Los Angeles, chairman of the board of directors, and C. B. Smith, the local manager in charge of the company's business. Work on the project will begin with all possible haste.

LOS ANGELES, CAL.—The contract has been awarded for the construction of a ten-mile extension of the Los Angeles Pacific Railway from Hollywood to Lankershim, thence five miles west to Kester on the Van Nuys ranch. Palmer, McBride & Quayle got the contract on a bid of $400,000 exclusive of right of way. Construction is to begin at once and the extension is to be completed and ready for operation March 1.

SEATTLE, WASH.—The Puget Sound Electric Railway has recently placed in operation on its main line between Seattle and Tacoma, two handsome high speed interurban cars, one being a combination baggage, smoking and passenger car, and the other a combination smoking, passenger and parlor car. On December 1st, the company established an especially fast limited service between the two cities mentioned, the running time being one hour and 10 minutes. Local trains are operated on an hourly schedule as heretofore, but the running time will be increased from one hour and 30 minutes to one hour and 45 minutes.

VANCOUVER, B. C.—The recent opening of the British Columbia Electric Railway Company's suburban line between New Westminster and Chilliwack, B. C., a distance of 63.8 miles, was attended by a number of leading citizens of Vancouver and Victoria, as well as by the councils of the various municipalities interested, who were guests of the company. The last spike was driven by Premier McBride in the presence of a large gathering. The company now has 200 miles of track on the mainland and 25 miles in Victoria. Other sections of the fertile Fraser valley will in the near future be served by lines to be operated by the Western Canada Power Company, whose great power development plant at Stave lake is approaching completion.

LOS ANGELES, CAL.—The Los Angeles Pacific Company has announced that in 1911 it will sell 60-ride individual commutation tickets for $3, good for 90 days; 30-ride family commutation tickets for $2.10, good for 90 days, and 40-ride school commutation tickets for $1.50 limited to the school term, for use between Los Angeles and Gardena Junction on the line reaching Hollywood and Highland avenue on the line reaching Colegrove. These will be good over any route and transfers will be issued to cars of the company at the termini. The company will also extend the 5-cent fare from Arlington to Vineyard on the Sixteenth street line. The company has informed the Public Utilities Commission of Los Angeles that it cannot consistently honor the present request of the residents of Hollywood and Colegrove for an extension of the straight 5-cent fare to those newly acquired suburbs for the reason that the country between is not thickly populated, there are no compensating short hauls and the bulk of the business would yield only ½ to ¾ of a cent per mile.

TELEPHONE AND TELEGRAPH.

VALE, ORE.—Mr. Labo, superintendent of the Malheur Home Telephone Company, with headquarters at Ontario, Ore., states that the company is making arrangements to put in a complete change in the local system. A plan is now under contemplation for the erection of a brick building in which to move their headquarters.

MONTGOMERY CREEK, CAL.—Herbert Bass of Montgomery Creek, president and lessee of the Redding, Ingot and Wengler Telephone Company, has arranged for the extension of the line. The company, which was organized four years ago and of which he was the original promoter, is capitalized at $10,000.

POMONA, CAL.—The Local Home Telephone Company is adding to its switchboard capacity by installing several new sections. This makes the ultimate capacity of the plant 5000 telephones, whereas under the present equipment but 3500 people can be served. The company is enjoying a rapid and steady growth.

ROSEVILLE, CAL.—The Roseville Home Telephone Company has made application to the Board of Trustees for a franchise to erect and lay telephone wires and to erect poles for such purposes in the streets, alleys and ways of the city of Roseville. The franchise will be sold to the highest bidder on January 2d.

ABERDEEN, WASH.—Negotiations have been about completed for the construction of a telephone line to connect Aberdeen and Westport. The movement, being backed by local shipping people, will when completed enable them to have direct communication with the United States life-saving station at the entrance of the harbor and by this means keep in touch with the arrivals and departures.

LOS ANGELES, CAL.—Charles E. Sumner, of Toledo, Ohio, who claims to own 1000 shares of stock in the Northwestern Long Distance Telephone Company, valued at $100,000, has filed suit in the Superior Court against William H. Allen, Jr., and Charles C. Porter, directors of the company. Sumner seeks to recover $55,000 on the ground that unauthorized indebtedness of that amount has been incurred. According to the petition Allen and Porter instructed P. L. Willis, president of the company, to create a bonded indebtedness of $55,000. The complaint states that the two directors control the board and that they are antagonistic to the interests of the stockholders.

WATERWORKS.

BRAWLEY, CAL.—City Engineer Park has been instructed to prepare plans and specifications for a water system on a basis of a cost of $30,000. The remaining $10,000 of water bonds will be used in well work.

RATON, NEW MEXICO.—An earth dam with a concrete core, costing about $150,000, is now being built twenty miles southeast of Raton, New Mexico. M. M. O'Shaughnessy is consulting engineer, and Mr. Smith, late of the Roosevelt dam of Arizona, is resident engineer in charge of construction.

ELY, NEV.—The extension of the mains of the Ely Water Company to the springs at the head of Murry canyon has been discussed by the Council and the city attorney has been instructed to take up the matter with the water company.

OAKLAND, CAL.—That for the four years ending June 30, 1911, the city of Oakland and its residents have saved almost $1,000,000 under the agreement for an annual reduction of the water rates made between the City Council and the People's Water Company, is the substance of a report filed with the Council by J. H. Dockweiler, city water expert. In January, 1907, at which time the People's Water Company purchased the plant from the Contra Costa Water Company, the rates were the same as those in 1903, when the city was enjoined by the Contra Costa Water Company from fixing a lower rate. Since that time there has been a reduction of the rates each year that, to the present time has effected a saving to the city of $117,251.36, and to the consumers $541,804.45. At the same rate, it is figured that at the end of the four years the total saving will be $902,000.

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JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV No. 27 — SAN FRANCISCO, DECEMBER 31, 1910 — PER COPY, 10 CENTS

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JOURNAL OF ELECTRICITY
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VOLUME XXV | SAN FRANCISCO, DECEMBER 31, 1910 | NUMBER 27

POSSIBILITIES OF CROSSING SAN FRANCISCO BAY BY ELECTRIC POWER

BY L. R. JORGENSEN.

At present electricity plays an important role in all branches of every day life, and judging from the rapid growth in the past it seems reasonable to expect great things from this form of power in a not very distant future. Almost every machine and vehicle on land can most readily be driven electrically; but so far few attempts have been made to propel ships by means of electric power fed to it through an overhead system or otherwise. There are many cases in existence, where this undoubtedly would be profitable, but it belongs to the future to develop a system of transmission suitable for this class of work.

View of Ferry Building and San Francisco Bay.

The writer while crossing San Francisco Bay every day has often wondered if this kind of transportation was the best possible for the case; if the time could not be cut down and if electricity could not be used.

The most rational way of cutting down the total running time for the trip would be the building of a tunnel underneath the bay, as has been proposed from time to time, and thus save the transfer of passengers to the boats and the comparatively slow boat ride. The most recent work of this character is the Pennsylvania railroad tunnels under the North River between New Jersey and New York, and for estimating purposes this type of tunnel will be used.

The "tube" consists of a cast iron shell lined inside with concrete. The outside diameter is 23 ft. and the inside 19 ft.; one tube accommodating one track. For a full description of this work see paper by Hewett and Brown, A. S. C. E., Vol. 36.

In order to make the submerged tube as short as possible the present Oakland pier should be used as far out as the filling would be allowed, the tube to start downward in the fill on say at 10 per cent slope and continue a few feet below the bottom of the bay across to San Francisco, due consideration being given to grades; if possible they should be kept under 1 per cent to avoid loss of power by breaking. In going through Goat Island the tube should

rise above the water-line in order to allow an ordinary tunnel to be substituted for the tube; omitting the cast iron shell. This cast iron shell is the most expensive piece of the whole construction, as it must be made much heavier than absolutely necessary for mechanical strength. The tube, 23 ft. outside diameter, in running through the silt displaces 415 cu. ft. per running ft. and as the weight of the silt is in the neighborhood of 100 lb. per cu. ft., the tube must weigh 41,500 lb. or more per running ft. in order to remain steady in its original location. After the weight of the inside lining, rails, electric ducts, etc., has been counted, there still remains about 12,000 lb. per running ft. to be provided for by the cast iron tube.

The west terminal station for suburban traffic if located under ground at the corner of Kearny and Market streets would be central and would permit of grades of less than one per cent for the last few hundred feet, where a much steeper grade would be economical to accelerate and retard trains.

The length of the tube below the water-line would be about 16,500 ft., the length of ordinary tunnel, through Goat Island and underneath Market street about 7000 ft.

Cost of one tube per foot 12,000 lbs. of cast iron segments with bolts @ 4 cents a lb. in place	$ 480
5 yards of concrete in place @ $10	50
Cost of boring below the water, per foot	30
Longitudinal reinforcing steel to guard against earthquake shocks and to make tube act like a girder, per foot	10
Rails, ties, etc	5
	$ 575
Engineering and incidentals, 15%	86
Total (per foot of tube)	$ 661
16,000 feet @ $661	$10,576,000
7,000 feet of ordinary tunnel and subway @ $160 per foot	1,120,000
Total for one tube (exclusive of electric installation)	$11,696,000

The total for two tubes will then amount to $23,392,000 + 1,000,000 for terminal station. Figuring 6 per cent interest on this cost and allowing 1 per cent for depreciation of structure the yearly cost due to these items will be $170,744 or about $470 per day. As this figure only covers part of the total expenses, in fact it represents the extra expense the company would have, if it changed over to tunnel generation from its present method. These extra expenses are so large as to prohibit the undertaking of tunneling underneath the bay under present conditions for any single railroad company entering San Francisco. If, however, all the railroads handling traffic on the bay could agree on one common project and each pay their proportional share, the project might be feasible at present. The advantage of the tube system over any other system that can be devised is of course apparent in the fact that the running time from the cities east of the bay to the business center of San Francisco can thereby be cut in half, an important item, although not so easily calculated in dollars and cents. As the boat service seems to be indispensible at the present time, the next question is, can electricity be substituted for steam on the boats and will it pay.

There are two ways of supplying electricity to motors driving ship propellers, one is by means of a storage battery and another by means of overhead feeders where this is possible. That a storage battery can be used on board a ferry-boat to drive the propellers is evident, but ordinarily it is not economical nor practical to do so and therefore, it is not used. The main reason why it is not practical to use storage batteries on board is that electricity costs too much at present and that the time the boat lays idle at each end of the trip is not long enough to recharge the battery at an economical rate. Twice the number of boats would be required to permit half of them to charge all the time, or else each boat would have to be provided with a much larger battery able to take a high charging current and resulting in a poor load factor besides being heavy and expensive.

In the course of the Key Route boats is an obstruction, Goat Island, preventing the boats from making the trip from landing to landing in a straight line. If this obstruction was eliminated it would serve a double purpose and make electrification of the Key Route boats feasible in the future, as shall now be shown. To eliminate this obstruction does not mean to remove the island, but it means a tunnel through the island big enough for the boats to sail through at full speed. The actual size of the tunnel required for this purpose is not so important to determine in order to get an estimate as to cost, as long as the rock is solid and lining or other supporting elements are not needed. From surface indications it can be taken for granted that the island consists of solid rock. Good crushed rock is worth more than $2 per yard delivered around the bay and it can be taken out of this big tunnel and crushed for less.

To make it possible to sail in a straight line between points of landing would require a tunnel about one-half mile long with approaches or about 1/6 of the total distance between landings. The most important feature of the tunnel is not that it makes the distance to be traveled shorter, but while going through this tunnel the battery can be charged from an overhead feeder system or a "third rail" and the motors draw current not from the battery but from the same system of feeders or from a separate system which furnishes current at 25 per cent lower voltage.

The battery receives energy instead of furnishing while the boat is traveling 1/6 the total distance. This is equivalent to 1/3 the total distance in case no means were at hand for recharging during the trip. If the ferry slips are also provided with a system of feeders in such a way that the charging can commence before the boat is actually at a standstill, the charging time can be made equal to the running time and no extra equipment is needed on account of having to charge the battery. The boat should be provided with four propellers operated by two independent shunt motors through Melville-Macalpine gears. The exciting current for the shunt should be regulated by cutting in and out cells and this operation accomplished from the pilot house. A rudder would not be absolutely necessary as the two motors could be made to run at different speeds corresponding to their field excitation; thus eliminating the effect of the tide current and ensuring

a smooth and straight landing, which in the case of having to commence charging the battery before stopping would be especially desirable. The operating voltage is supposed to be 500-600 volt. A sub-station would have to be built in the tunnel provided with rotary converter, transformers, etc., for feeding the boat while going through the tunnel and for feeding the San Francisco slip through submerged feeders.

At present the Key Route Company generates the electric power necessary for the generation of its railways by means of steam. Although the equipment seems to be efficient, the cost of generating a kw. hour must be in the neighborhood of 1¼ to 1½ cents per 24 hours and the cost of generating a h.p. hour on the boats more than one cent on account of the frequent stops. Should the boats be electrically driven and develop the same number of horsepower as the steam driven, we would have to supply quite a number of additional horsepower to make up for the electrical losses in motors, low tension transmission, rotary converters, transformers and battery with a total efficiency of $95 \times 90 \times 97 \times 98 \times 80 = 65\%$.

The two schemes, steam and electricity, will in this case be equal as far as power cost is concerned, if electricity can be bought from a transmission company for 0.65 cents per h.p. hour. The investment for an electrically driven boat is, however, larger than for a steam driven one, especially if we want to install more power, and to put the two propositions, steam versus electric driven boats on an equal basis, would necessitate a price of not more than ½-cent per electric horsepower hour.

Water-power plants can be built in California today for such an amount that power can be delivered and sold at a profit at ½-cent per h.p. hour in large quantities for a 20 to 24 hour load. As the industry progresses, this figure can possibly be cut down and as the cost of steam power is bound to increase in the future, it is evident that the use of electricity will spread into fields from which it is now excluded. From the above is seen that fuel needs to increase but little in price and water-power need to drop but little in price before the scheme of electrification of ferry boats in special cases is entirely justified from a financial standpoint.

As far as reliability of service is concerned electric motors are as reliable as steam engines and much cheaper to keep in repair. An electric storage battery charged is the surest thing on earth for power delivery. Should the long distance transmission fail for short intervals (preferably such a system should be connected to several power companys' lines) it would cause no interruption, the battery could simply be given an extra charge over night to make up for it. The size and weight of the battery would to a large extent depend upon the efficiency desired, that is, upon the rate of charge and discharge, upon which also maintenance charges depend. With a battery installation the center of gravity of the boat could be brought much lower, more space would be available for passengers and a larger power equipment could be put below the deck. As the motors should be controlled from the pilot house, one, or at the most two men, would be sufficient to look after the power equipment below and in this way compensation would be had for the somewhat larger investment in electric equipment. At present power companies do not sell and perhaps cannot sell power at ½-cent per horsepower hour or lower; therefore, until that time arrives much change in handling the traffic across the bay can not be expected, as it would not be economical to do so.

Map of San San Francisco Bay.

THE HUMPHREY PUMP.

H. A. Humphrey has invented a novel gas pump which is capable of many applications described in a paper he recently read before the Manchester (England) Association of Engineers. In the words of the author it is "a method of raising or forcing liquid which consists in applying the energy of expansion of an ignited combustible mixture to one end of a column of liquid so as to propel the column along a discharge pipe, and to cause it to oscillate in the pipe under such conditions of energy of the moving liquid, that everything necessary for preparing for the next ignition is performed during one or more oscillations, and wholly or partly owing to it or them."

Referring to Fig. 1 water is to be raised from supply tank S T to an elevated tank E T; C is the combustion chamber, W the water-valve box, V valves opening inwards, and D the discharge pipe. In the top of the

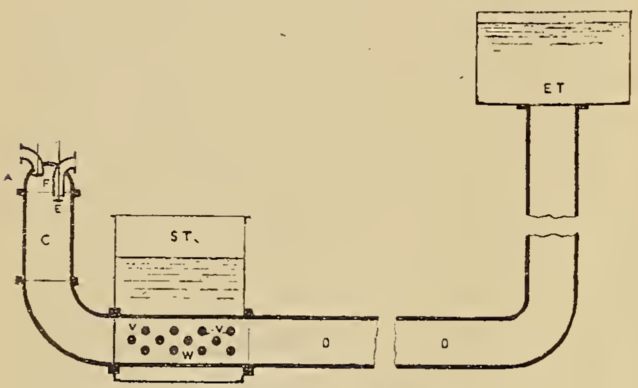


Fig. 1. Humphrey Gas Pump

combustion chamber is an inlet-valve A and an exhaust valve E. A simple interlocking gear is arranged between these two valves, so that when valve A opens and closes it locks itself shut and releases the valve E, and when valve E opens and closes it locks itself shut and releases valve A; consequently each time the suction occurs in the chamber these valves open in turn. Imagine a charge of gas and air to be compressed in the top of chamber C, and fired by a sparking plug which projects through the top casting. All the valves are shut when explosion occurs, and the increase in pressure drives the water downwards in the pump and sets the whole column of water in the discharge pipe in motion. The column of water attains kinetic energy while work is being done upon it by the expanding gases, so that when these gases reach atmospheric pressure the column of water may be moving with considerable velocity. The motion of this column of water cannot be suddenly arrested, hence the pressure in C tends to fall below that of the atmosphere, the exhaust valve E opens, and also the water valves V. Water rushes in through the water valves mostly to follow the moving column in pipe D, but partly to rise in chamber C in an effort to reach the same level inside the chamber as exists in the suction tank.

When the kinetic energy of the moving column has expended itself by forcing water into the high-level tank, it comes to rest, and there being nothing to prevent a return flow, the column starts to move back towards the pump, and gains velocity until the water reaches the level of the exhaust valve, which it shuts by impact. A certain quantity of burnt products is now imprisoned in the cushion space F, and the energy of the moving column is expended in compressing this gas cushion to a greater pressure than that due to the static head of the water in tank E T. Hence a second outward movement of the column results, and when the water reaches the level of valve E the pressure of the space F is again atmospheric, and further movement of the water opens valve A against a light spring and draws in a fresh charge of gas and air. If there were no friction the water would fall to the same level as that from which the last upward motion started, but the amount of combustible charge drawn in is slightly less than this movement would represent. Once more the column of water returns under the elevated tank pressure and compresses the charge of gas and air, which is then ignited to start a fresh cycle of operations.

The pumps may discharge into an air vessel, or an open stand-pipe, if desired to give a continuous flow.

With a compression pressure of 11 atmospheres absolute the theoretical thermal efficiency of the Humphrey cycle is 52.5 per cent, while that af the Otto cycle is 40 per cent. A compression of this order will be employed in a 1000-h.p. German pump; the author has only used pressures up to 50 lb. per sq. in., obtaining an actual efficiency of over 23 per cent, corresponding to 0.95 lb. anthracite coal per water h.p. hour on a lift of 35 ft.

A large scale experiment is to be tried in which a Humphrey pump will be used to drive a water turbine coupled to an electric generator. The advantages of such an arrangement over the ordinary gas engine arise chiefly from the simplicity of the working parts, the absence of all troubles arising from contraction and expansion due to heating and cooling, the freedom from cyclic irregularity, thus enabling alternators to be driven in parallel, and finally, the high efficiency and the low cost of upkeep. Also the apparatus may be started and stopped immediately, and can, indeed, be entirely controlled from a switchboard. One has to face the loss due to conversion of water-power into mechanical energy, but the efficiency of well-designed turbines can be guaranteed at over 80 per cent at full load, and in a central station there is no need to run any of the pumps at less than full load, since they can be so easily started and stopped. Moreover, if blast-furnace gas or producer-gas derived from cheap fuel is used, the loss of 20 per cent of the energy is not important, as compared with the advantages gained by the adoption of the gas-hydro-electric system, and the absence of the need for any lubrication would alone more than compensate for it. It is also proposed to apply the Humphrey pump to marine propulsion, and designs have been worked out for this purpose.

ELECTRICAL EQUIMENT OF THE LAS VEGAS SHOPS OF THE SAN PEDRO, LOS ANGELES AND SALT LAKE RAILROAD COMPANY.

BY JULIAN ADAMS.

The new shops at Las Vegas, Nevada, of the San Pedro, Los Angeles and Salt Lake Railroad Company at present consist of machine shop, blacksmith shop, boiler shop, transfer table, roundhouse and power-house. The buildings are of fireproof construction, being built of hollow concrete blocks and steel framework. A storeroom of similar design is under construction and the plans, when complete, will include a well-equipped mill and carpenter shop, it being intended to handle all the company's heavy repair work in these shops. A 100-ton crane travels the length of the machine and boiler shops, and an additional 10-ton crane is provided in the machine shop.

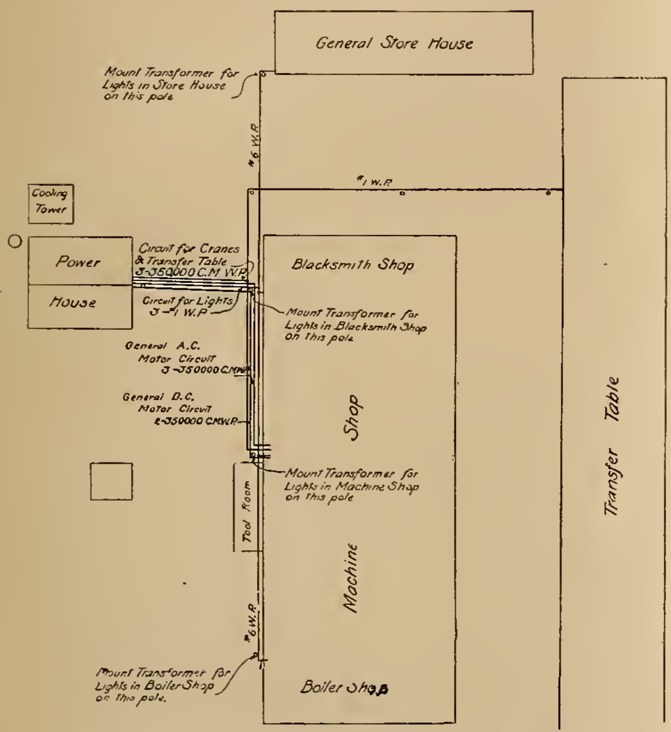


Fig. 1. General Layout of Motor and Light Circuits for Shops.

All the machine tools in machine, blacksmith and boiler shops are driven by individual direct connected motors, with the exception of a few of the small tools which are arranged for group drive. The individual drive was adopted in general in preference to group drive on account of the well-known advantages to be gained, which consist of: Increased output of machine tools; elimination of shafting and belting maintenance; increased light due to elimination of shafting and belting; the ability to operate a single machine at any time without the necessity of operating other machines; reduction in size of power plant required by reducing fractional losses; and saving in fuel due to reduction of frictional losses.

In deciding upon the type of electrical apparatus to be installed, the relative advantage of both alternating current and direct current systems were compared for the conditions to be met in these shops, having in view the ultimate addition of mill and carpenter shop. The final decision was in favor of a general alternating current system supplying alternating current for all constant speed machine tools, cranes, transfer table and lights, a motor generator set being installed to supply direct current for variable speed machine tools. The most important features governing the choice of the general alternating current system are the extremely low maintenance cost of alternating current equipment as compared with direct current equipment and the greater flexibility of the alternating current system for general light and power circuits in the shops. For variable speed machine tools, however, it was not considered that the present state of development of the variable speed a.c. motor warranted its adoption and d.c. motors were installed with field rheostatic control. The d.c. motors all operate at 230 volts, the a.c. motors at 440 volts, 3 phase, 60 cycles, and the a.c. lights at 110 volts. The following table gives the sizes and kinds of motors in the present equipment:

	Motor.	
Tool.	A.C. H.P.	D.C. H.P.
90" Driving Wheel Lathe	5	50
90" Driving Wheel Press	10	
90" Quartering Machine		3
		3
44" Car Wheel Grinder	40	
36" Vertical Turret Boring Mill	9½	
36" Triple Geared Engine Lathe		10
24" Vertical Turret Boring Mill	5	
24" Engine Lathe		10
16" Portable Engine Lathe	3	
24" Turret Lathe		15
No. 4 Plain Miller	10	
36" x 16' Open Side Planer	20	
36" x 16' Open Side Planer	20	
32" Draw Cut Shaper		5
5' Universal Radical Drill	5	
30" Radial Drill	3	
24" Vertical Drill Press		7½
Multiple Drill, two spindle		7½
Multiple Drill, two spindle		7½
Multiple Drill, two spindle		6
	7½	6
51" Boring Mill	3½	
No. 2 Horizontal Boring Mill		5
18" Slotter		7½
1½" Triple Bolt Cutter	3	
3" Forging Machine	20	
1½" Forging Machine	10	
3" Horizontal Punch	7½	
60" Single Punch	10	
Rotary Bevel Shear	10	
Rotary Splitting Shear	7½	
6' Rolls	3½	
12" Rolls	20	
Flue Rattler	10	
Alligator Shear	15	
24" x 6¼" Turret Lathe		7½
No. 3 Single Punch	10	1
Blower	10	
Exhauster	15	
Group Drive	20	
Group Drive	20	
Group Drive	20	
	52	
	52	
100-ton Crane	22	
	30	
	52	
	22	
10-ton Crane	15	
	5	
Transfer Table	50	
Total	753	151½

Fig. 1 shows the general lay-out of motor and light circuits for the shops.

Fig. 2 shows a 60-in. single punch with a direct-connected 10-h.p. a.c. induction motor.

Fig. 3 shows a 90-in. driving-wheel lathe with a 50-h.p. d.c. variable speed direct-connected motor.

Fig. 4 shows the exterior of the power-house. The wall in the one end is temporary, to allow for future extensions.

The boiler equipment in the power-house consists three 250-h.-p. Stirling boilers operating at 150-pounds

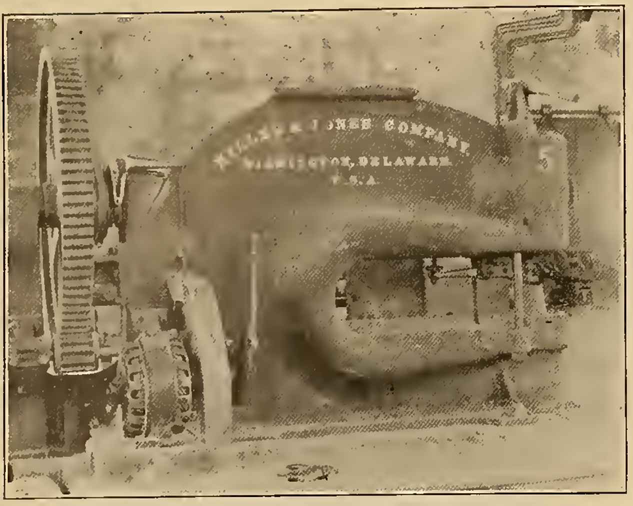


Fig. 2. 60 in. Punch With Direct-Connected 10 h.p. A.C. Induction Motor.

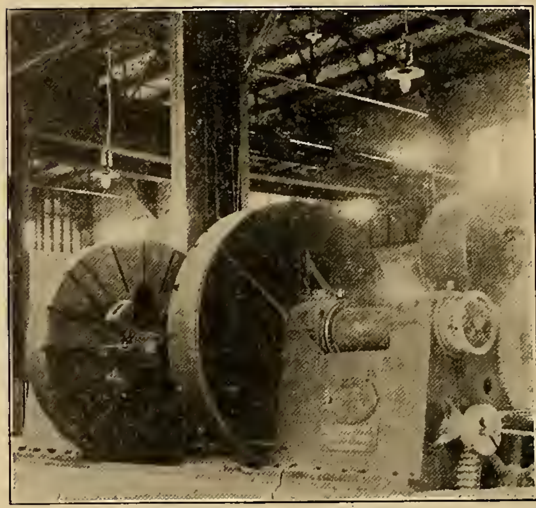


Fig. 3. Lathe With 90 in. Driving Wheel and 50 h.p. D.C. Variable Speed Motor Direct Connected.

pressure and 80 degrees Fahrenheit superheat. Oil is used for fuel and is pumped with a C. C. Moore fuel oil pumping system to the Hammel burners used in the boilers.

The generating equipment consists of two Allis-Chalmers 300-h.p. horizontal cross-compound condensing Corliss engines, direct connected to two Allis-Chalmers 200-kw., 440-volt, 3-phase, 60-cycle, 150-r.p.m. generators with belt-driven exciters. A 100-kw., 440-volt a.c. to 230 d.c. synchronous motor-generator set furnishes direct current. This motor-generator set is self-exciting and is not provided with any starting equipment. It is thrown on the line before the engines are started and is gradually brought up to speed as an induction motor as the engines are brought up to speed.

The switchboard consists of seven panels with General Electric switchboard instruments. There are two generator panels, one a.c. and one d.c. panel for the motor generator set, and three a.c. feeder panels, one of which controls the circuit for cranes and transfer table, one the lighting circuit and the other the general a.c. motor circuit for machine, blacksmith and boiler shops.

Fig. 5 shows the wiring diagram for the power house.

Besides the generating equipment the engine room contains one 1600 cu. ft. per min. Ingersoll-Rand cross-compound, condensing air compressor, full load speed being 150 r.p.m., and the air pressure being 100 pounds.

The condensing equipment for each Allis-Chalmers engine consists of one C. H. Wheeler surface condenser having 570 sq. ft. of cooling surface, together with one 6 in. x 4¾ in. x 12 in. Pratt patented Rotrex vacuum pump and one 5 in. centrifugal circulating pump both

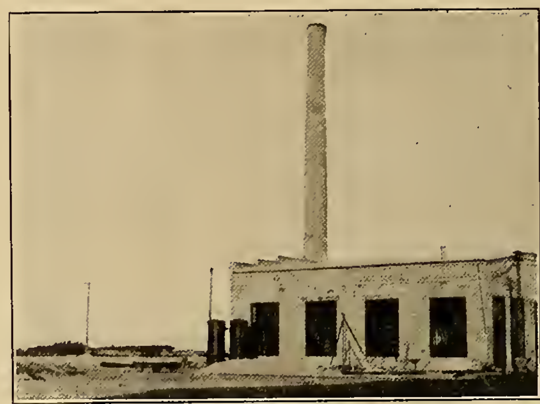


Fig. 4. Exterior of Power House.

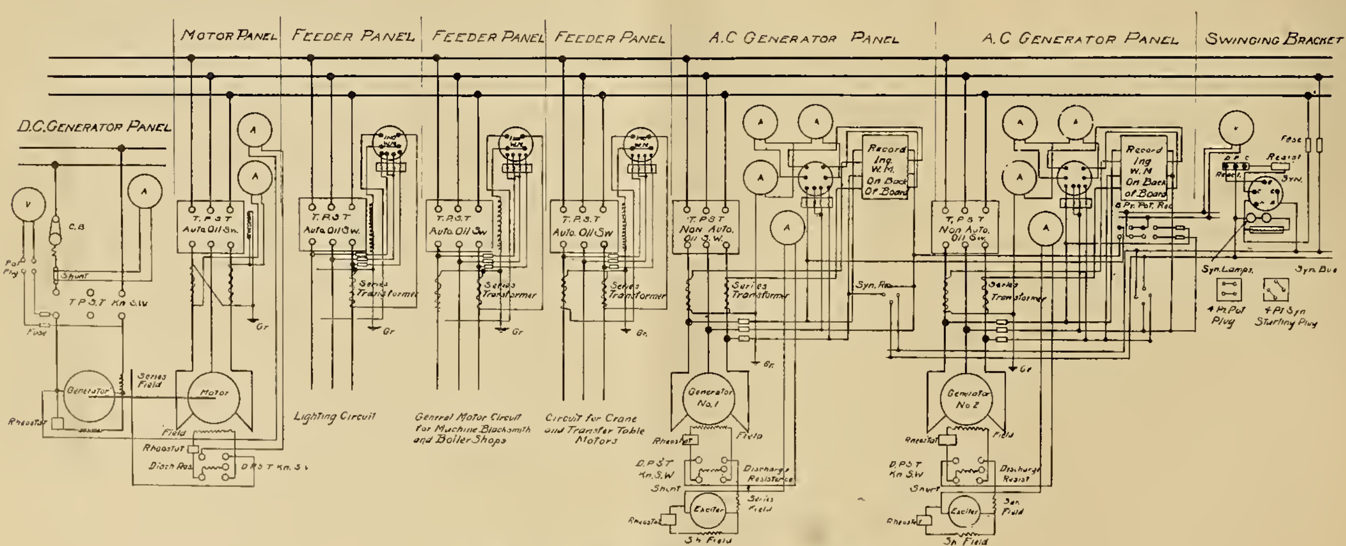


Fig. 5. Wiring Diagram of Power House.

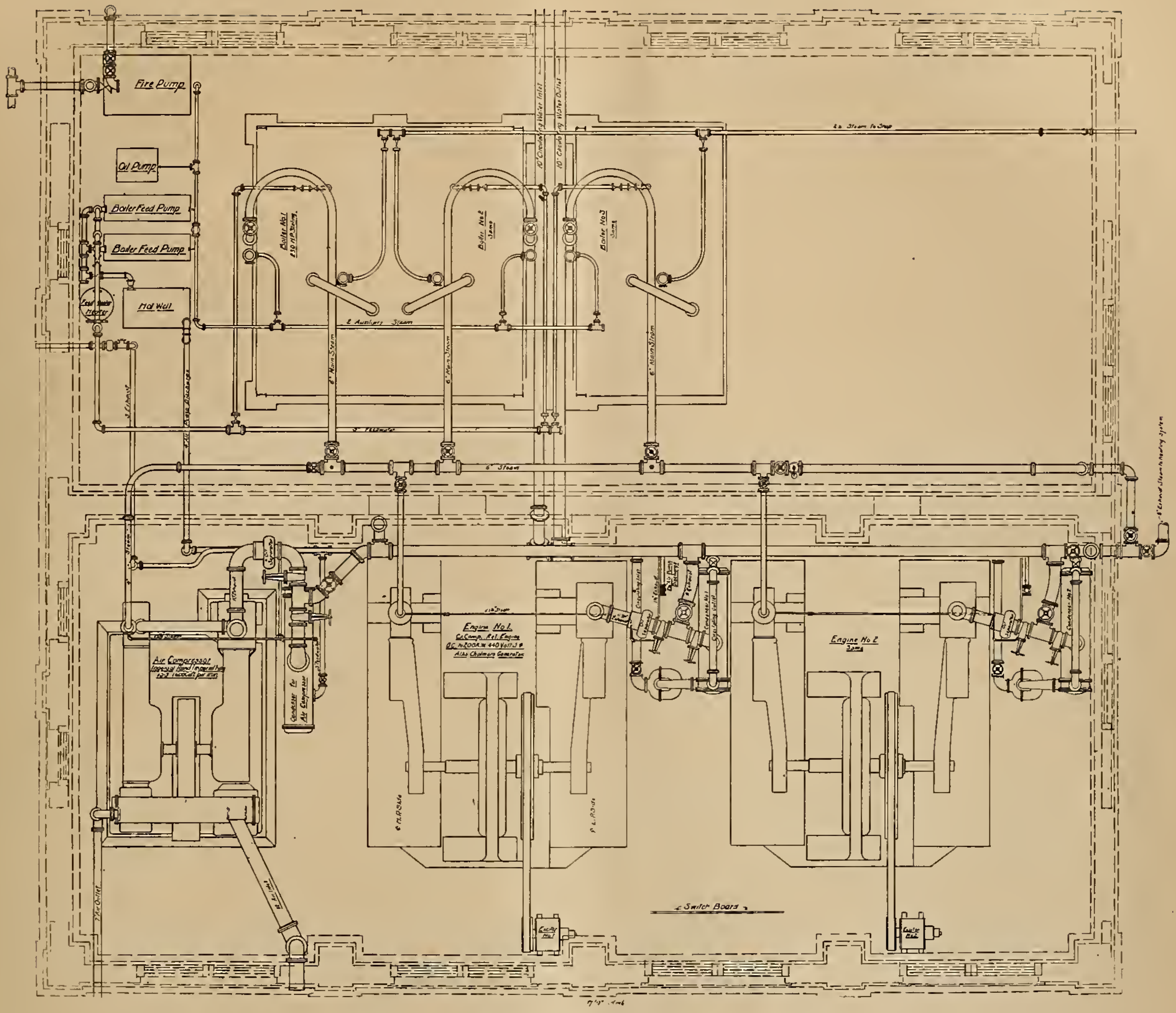


Fig. 6. General Piping Layout of Power House.

direct connected to one 5 in. x 5 in. vertical high speed engine. A Knowles Worthington surface condenser is used in connection with the Ingersoll-Rand air compressor. In the case of all three units a Cochrane vacuum oil separator is installed between engine exhaust and condenser.

The boiler feed water pumps consist of two Worthington compound outside center packed 6 in. x 9. in. x 4½ in. x 6 in. pumps.

The exhaust steam from these pumps and from the condenser air and circulating pumps is used for heating feed water in a Goupert feed water heater.

All condensation from high pressure piping system and water separators is returned to the boiler by means of a Crane direct return trap. All condensation from receivers and exhaust piping is returned to the hot well by an automatic return pump.

Fig. 6 shows the plan of the general piping lay out of the poper house.

The limited amount of water available made it necessary to construct a cooling tower for use in connection with the circulating water for the condensers.

DAM DESTRUCTION BY GROUND SQUIRRELS

Ground squirrels have a habit of burrowing in embankments. In the flat country they seek small elevations from which they can better observe the approach of their enemies. Dikes, levees, roadways and embankments of all kinds attract them and are often seriously undermined by their burrows. In the irrigated districts their underground tunnels, like those of the pocket gophers, frequently cause breaks costing large sums to repair. Thus in May, 1910, ground squirrel burrows caused such a serious washout in the Turlock Canal in Stanislaus County, California, that the line of the canal had to be changed at a cost of $25,000. The break occurred during the latter half of May, and the labor of rebuilding the waterway occupied about three months, depriving the ranchmen of water at the very time it was most needed for the irrigation of their alfalfa and other products and entailing a loss of upward of half a million dollars.

THE INTRODUCTION OF THE GAS FURNACE.[1]

BY CHAS. F. STAMPS.

The development and introduction of the gas furnace as a competitor of the older styles of furnaces using wood, coal and oil as fuel affords material for one of the most interesting of chapters on gas appliances. In all countries and at all times the prevailing systems of heating have conformed necessarily to the conditions which prevailed at the time and place. In those sections where wood and coal were plentiful and cheap, and gas was high, it followed, as a matter of course, that the gas furnace would be used only by the few who cared less for the added expense incurred than they did for the increased comfort obtained and greatly reduced trouble and attention required in its operation.

With the discovery of natural gas, however, and its remarkable cheapness, immediate attention was called to the possibilities of its use in the localities supplied, as a fuel within the reach of all, and the rapid introduction of appliances for its use in cooking, heating and manufacturing followed. The very abundance and cheapness, however, of the natural gas in these favored sections seems to have operated to defer the invention of a gas furnace worthy of the name, for the good reason that economy was uncalled for, and there was no need to trouble one's self about the invention of a furnace constructed on scientific principles, as long as a flat rate of one, two or three dollars per month could be obtained for unlimited service. Thus for a time the crudest of appliances filled the requirements of the users and if the supply of cheap gas had held out undoubtedly there would have been a continuance of the slack methods of its use. But lessons were being learned. Time is money and comfort is worth paying for. The saving of time and labor, the cleanliness and ease with which the volume of heat could be controlled and regulated, appealed to the judgment of every customer and the public mind was educated to the real need for gas as a fuel for all domestic purposes.

The discovery of oil in California, followed by the invention of methods for its use in the making of gas in abundance, and at a price "within the reach of all" brought the opportunity to our door here in sunny California, where the high prices of coal and wood as well as the climatic conditions combine to make it the ideal country in which to make use of the advantages which the gas furnace most undoubtedly possesses over all other types of heating systems.

Quite naturally then, we have here a prolific field calling for invention and, true to the law governing demand and supply, we find the answers coming from many quarters. For the past seven years particularly there has been especial activity in this line, and the evolution of the gas furnace from the first crude efforts of that date to the types now being turned out affords an interesting study. Sufficient advance has been made to command the attention, and it is safe to add also, we think, the respect of the most conservative gas officials, who, for several no doubt very good reasons, have been slow heretofore in lending their endorsement. Now, however, with increased facilities for supplying gas in large quantities and at a price within reach of the general public, the opportunity becomes of immense importance and the propriety of lending every assistance within reason in the matter of rates at which "gas for furnace heating" can be supplied, it is hoped will receive their most serious attention. A little encouragement given along this line of reduced rate on gas used in furnaces would doubtless greatly increase its use, and the company that first proffers the concession would receive from the public in return, the good will and patronage it deserved.

The question of the hour, and the one in which this association is interested, however, resolves itself briefly to the point of efficiency actually attained in the best types of gas furnaces on the market, and the general principles of their construction, etc. Without mentioning any special furnace or its manufacturers it is sufficient to say that the gas furnace has established for itself a record of efficiency and merit which entitles it to our confidence. The difficulties met in the earlier efforts have been largely overcome and improved methods of construction have at last given us a product that it is confidently believed will stand the test of time and use. To attempt a description of the many types of furnaces brought out to date, would be out of the question in an article as limited as this must necessarily be, suffice is to say that experience has proven unquestionably a few things at least, among which are the following, viz:

(a) That the successful gas furnace must be provided with a vent by means of which all impurities of combustion can be carried off.

(b) That the vent should be taken from the bottom of the furnace.

(c) That the first essential is perfect burners, and of not too large size.

(d) An increase of the radiating capacity to the highest degree possible.

(e) A method of construction permitting the taking apart of the furnace for the purpose of cleaning it by removing the products of condensation.

(f) A method of construction and above all a manner of installation in every case, that will allow the freest possible passage of the air to be heated, through the furnace, consistent with the heating capacity of the furnace.

A careful study of these principles and comparison of the different methods of construction employed will be a valuable help either in the development of a new furnace or in making a selection of the best from among those already on the market. Undoubtedly there will be more or less important improvements made in the days to come but enough has been already achieved to place the gas furnace along side of the gas range and water heater as an assured success, and we predict for it a future limited only by the available supply of gas and the price at which it can be delivered to the consumer.

A conservative estimate of the total number of gas furnaces installed thus far in Southern California, including all the different makes, numbering at least nine of local manufacture and one from the East, would probably not fall short of eight hundred, the most of which have been put into use during the past two years.

[1] Paper Read at Eighteenth Convention Pacific Coast Gas Association.

DISCUSSION AT EIGHTEENTH ANNUAL CONVENTION, PACIFIC COAST GAS ASSOCIATION.

The Introduction of the Gas Furnace.

Mr. Basford: I have had some experience with the gas furnace. If every maker of gas furnaces would study the rudimentary elements of the subject of gas heating, and endeavor to get the best out of them, with reference to the radiating surface, but more than all the top of the burner, that would be an easy question to answer. The trouble with the majority of makers of gas furnaces, is that they have the same ideas as they had ten years ago. They think all you have to do to get a gas furnace, is to put a flame under a drum; that is the meaning of a gas furnace in simple terms. That all you have to do to get acetylene, is to add water to calcium carbide; but there is a vast difference between the elements and the operation of a machine. Now then, I believe that there is no other one device, that has been such an enemy to the gas companies, as the gas furnace. Not because it is called a gas furnace, but because of the class of furnaces they are manufacturing. They are certainly poor, some of them. I believe it is up to the gas companies to investigate every gas furnace on the market, and unless it has the reasonable application of scientific principles of operation, they should frown upon it, because it is taking money out of their pockets. This is an expression that I frequently hear: "You will please excuse me, I wouldn't use a gas furnace. It costs more than anything else in the world to run, and in two years' time you have to get a new one." Answering the last question, in regard to the use of wood and coal as compared with gas. Coal is the cheaper fuel. However, if the gas furnace is used intelligently, if the manufacturer would instruct his people in the use of them for the first winter at least, you will find that there will be a marked improvement in the situation. You know that gas burns until you put it out, but coal goes out. I think that the people should be instructed by the companies and given a fair knowledge of the use of gas furnaces, and in that way the companies should supervise the installation of furnaces they put on the market.

Mr. Berkley: We had occasion last winter to make some experiments as to the cost of heating bungalows and small houses. By an arrangement we put in two meters in some houses with the understanding that we would remove one of them as soon as the demonstrations were over. I do not know the make of the furnaces used, but I do know that the people were greatly satisfied with them. The cost of operation was not exorbitant. I advocate gas furnaces, but if we could make some improvements on them as to economy, we would have a great deal more business than we now have. I believe we should assist the gas furnace builder; it is not a hard or unsurmountable problem, but being a physical proposition it can be solved within a reasonable time so that we all can heat our houses with gas profitably. I contemplate using gas this winter instead of solid fuel; I find it is as cheap, for with coal at $12.00 per ton and wood at $9.00 per cord, there is economy in its use. The comparison just drawn does not compare for the fact we are all more or less negligent with the use of solid fuel; having been brought up in its use where there was no restriction on the amount of fuel we used when farmers' boys. Now, when we buy fuel by the hundred feet it becomes a different matter. I think today we have a great opening for the sale of gas to be used in gas furnaces, for sunny California needs heat, as any Easterner will attest. I think we ought to start some concerted plan of action in regard to gas furnaces; it will bring the greatest returns.

Thaddeus Lowe: Being interested in a company manufacturing gas furnaces and stoves, I can hardly sit still and hear the statements which have been made, without having something to say. What the gentlemen did say was true to a certain degree today. That is that the construction of a gas furnace does not take into consideration its economy. Being more or less in the gas business ever since I was born, I realize the fact that to increase the use of gas and keep the people satisfied, you must give them plants that are economical, and we have been experimenting along those lines for a number of years past, and we believe today, that we have as perfect a gas furnace as it is possible to obtain. I wish to say in regard to our gas furnace that we have a great many in use. One of them has been in use for at least seven years, and it is in use today, and the bills compare favorably with the bills of any other fuel. We all know, of course, that gas flows easily, and it is a whole lot easier to let it flow than it is to step down stairs and turn it off. I do want to say that if there was a little attention given to it, that the average person would not do away with it. It is too great a convenience. It does away with wood, and coal and the care of looking after them, as well as dirt and ashes. We have placed twenty-five or thirty furnaces and we have now about twenty orders and all these orders were obtained upon the recommendation of people using them during the last two or three years. We have a furnace heating the Episcopal Church in Pasadena, and during Lent, when they were having service practically every night, the bill for one month was $23.00. The inside height of the church is thirty-nine feet; it is constructed of granite and brick, and has a cement floor. The temperature ranged anywhere from freezing up to 50 degrees about that time. It was the coldest month in the winter.

Mr. Lenkfeld: I would like to say a few words in regard to the gas radiators. Mr. Lowe said he had some on exhibition in the building, and invited us to look at them. I have taken the privilege of doing so, and I cannot find any improvements on Mr. Lowe's radiator, over the ones which I used for years and years past. Now if I am wrong in my estimation of getting heating units out of gas, I stand corrected. But I want to say that we all know that the gas range would only give about 75 per cent of the heat, which is obtained from the gas range without a gas furnace. We would have 100 per cent with an air mixture. There should be a way of getting a gas and air mixture in a gas radiator or gas heater. Now what is best with a range is best with any other heating device. I feel sure that if we shut off the air mixture from the gas range, that the gas range will not give any satisfaction at all. It will not get the heat units out of it, as it will with the air mixture. I would like to see a trial made of that.

L. P. Lowe: I am not the Lowe who has anything to do with the heater down stairs, but in the absence of my brother, I will do what I can to reply to Mr. Lenkfeld. In the first place, it should be definitely understood, by everyone in the gas business, that you cannot increase the heat in gas. That is physically impossible. If a cubic foot of gas contains 650 British thermal units, you have no more, no less. All you can do is apply the heat differently. If you burn that gas in a yellow flame, as we do when we use it for lighting purposes in an open flame burner, you get just as much heat as when mixed with air; the only thing accomplished by burning it with a mixture of air is to consume it in a smaller space. There is no gas heater in the world better than any other heater, so far as the actual development of heat is concerned, the only difference being in its application. The principle point is to use as much as possible of the heat. If you allow all the products of combustion to escape in a room, without taking any off through a flue, you will get every unit of heat in the gas, provided you consume all that gas, no matter what kind may be the heater. Because of the presence of sulphur compounds it is not well to allow the products of combustion to escape in a room in any large quantity. It may be well enough to heat a bath room in that manner, but to allow the products of combustion to escape in a room from a heater burning 40 or 50 feet of gas per hour, would be bad practice. The sulphur in gas, in combination with the water, due to combustion, forms sulphurous acid, which is ruinous to fabrics, pictures, frames, furniture, and other articles.

It is, therefore, necessary, in burning gas in large quantities, to allow a little heat to escape in a flue in such a manner as to create a draft in order to carry off the products of combustion. A heater must also be so constructed that it can be kept warm throughout while in operation. If it is not so kept, the condensing products of combustion will form sulphurous acid which will destroy the metal of the heater; therefore the crucial point in the construction of any heater is to design one that will extract all the heat, save only enough escaping in the flue to create a draft to carry away the products of combustion. A heater may be so constructed as to extract all the heat from the gas before it reaches the flue, and if so you will have no draft, and such a heater would be faulty, though you might create an artificial draft, as they do in England, by burning a jet of gas in the flue and so get just enough heat to carry away the products of combustion.

Chemical Control of Gas Manufacture.

Mr. Jones: Gentlemen—In my opinion Mr. Hall has presented as good, if not the best technical paper, that has ever been presented to the Pacific Coast Gas Association. It is full of good common sense, and every statement he has made in it, is backed by a good reason. We certainly ought to extend a vote of thanks to Mr. Hall, for the time devoted to the preparation of this paper. I would like to ask Mr. Hall one or two questions. In the washing of gas with oil, you mention that you heat your oil to a temperature of 130 degrees Fahrenheit How do you maintain that temperature?

Mr. Hall: In regard to keeping the oil at that temperature, we have on the bottom of the pump, a heating chamber, which is furnished with steam from the pump itself, so that the faster the pump runs, the more exhaust steam is sent into the oil supply.

Mr. Jones: Between the vapor tension of napthalene vapor, and the vapor of the more stable illuminants, the hot oil affects one, whereas it does not affect the other.

Mr. Hall: We didn't go into the difference of the various hydro-carbons, because we have had no loss of candle-power.

Mr. Jones: Have you determined what takes place if the heat of the oil is more than 130 degrees Fahrenheit? How do you determine the desirable temperature?

Mr. Hall: We have found that that temperature is the one which would take out practically the least amount of napthalene, and yet not injure the candle-power.

Mr. Wade: In regard to this fire brick question, which has just come up, I might say that I have analyzed one sample of the brick made in Los Angeles, and I find the per cent of iron is considerably less than mentioned by Mr. Hall. I don't remember the exact analysis; but it was less than 3 per cent. There is one point about oil I would like to bring out, and that is that gas men should buy oil on the heat unit basis, and not by the gallon, car load or ton, but buy it by so many heat units. You cannot use oil that is too heavy on account of physical reasons and not chemical reason.

Mr. Lowe: As a matter of fact, the information relative to the accurate test of water in oil is not nearly of so much commercial value as scientific, by reason of the fact that the oil companies set forth in their contracts the method we shall use in determining the water. If we use more accurate methods and attempt to deduct for water from our bills, the deductions will not be allowed. We must test in accordance with the terms of the contract, and if we use greater refinements, they will charge more for the oil. Therefore, the discussion on this point is of greater technical value than commercial.

As to Mr. Hall's paper, it is manifestly impossible to discuss an effort of its excellence in a convention of this kind. It is one of the most valuable of the contributions to the literature of this Association.

Mr. Lowe: The reason that this paper is particularly interesting to me at this time, and likewise to the other gas companies making and delivering it in the City of Los Angeles, is because of the enforced conditions under which the city gas inspector is compelled to make his tests. Mr. Schade, as I understand it, is making a daily calometeric test of the gas furnished by the three companies, and from that calometeric test he determines the photometeric value of the gas by multiplying of factor of three; that is to say, that if a gas contains 600 B.t.u. by the calometeric test he assumes that gas to be 18 c.p. on the general assumption that 100 B.t.u. represent 3 c.p. of gas. Mr. Hall's determination shows that Mr. Schade, in adopting this method, is giving those of us delivering gas in the City of Los Angeles, too low a photometeric value, as Mr. Hall's determination shows that a gas of 600 B.t.u., instead of having 18 c.p., would be really about 19. I don't know whether any of the rest of you are attempting to estimate your values in that manner, but if so I especially recommend this chart for your consideration.

Mr. Schade: I didn't want to speak on this subject, gentlemen, because I have taken up considerable time on other questions, but since my name was mentioned, I will admit that the statement is correct. I am a hard worked man; I have more work than I really can do, because I do a great deal of work that does not belong to my office at all, but I am working for the benefit of all the people of the City of Los Angeles. However, I will say that I have to minimize my work as much as possible, and therefore I have to adopt time saving methods. That is the reason why I use the factor of 3 to multiply the heat units, a test which is practically correct. I don't know what others use, but I used to use the old regular candle test, but have discarded it and replaced it in my photometer, with Elliot's kerosene lamp, because the candle test was unsatisfactory, on account of the fact that frequently the candle would burn more rapidly on one side than the other, almost cutting a channel along the side of it, destroying the accuracy of the test and naturally the candle would have to be thrown away and the work done over. Besides the cost which is twenty cents per candle, amounting to $120 a year, is much greater than by the use of Elliot's photometer lamp, where less than ten gallons of the best kerosene will do the work, amounting to but $3 per year. It is a well known fact that 32 heat units of carburated water gas will carry 1 candle-power, while of crude oil water gas, 32 heat units are required to carry 1 candle-power.

Mr. Jones: I have known a calometeric test of non-luminous coal gas which showed 750 B.t.u. Natural gases have from 650 B.t.u. to over 1000 and they are non-luminous; therefore I don't see how you can multiply heat units by a factor to arrive at the candle-power of a gas.

Mr. Schade: He is absolutely correct, but I handle gas manufactured here, and it holds good as to gas manufactured in this city and practically on the Pacific Coast.

Mr. Britton: For the benefit of a good many gas men who are not chemists, I would like to ask Mr. Hall to give an explanation of what transformation takes place by oil washing in the naphthalene vapors that occur in the gas, prior to the gas washing.

Mr. Hall: We need a high compression to clean them of their naphthalene and benzine vapors, that is throw down the benzine and naphthalene substances leaving a residium, the gas being carried forward to the purifiers. Gas can be deprived of its illuminating power, that is practically, by compression, but it can be restored to life again by the absorption of benzol vapors.

Mr. Britton: Have you a theory to advance on the question of absorption by naphthalene vapors by the oil, heated at a temperature of 130 degrees; that is taken up in another form, from the gases passing through that body of hot oil?

Mr. Hall: I will say that naphthalene after being dissolved passes more into the solid. The transformation of naphthalene in vapor does not pass through liquid form, and when they receive it, it is a hydro-carbon in a class by itself, and with the other hydro-carbons, the vapor tension is such that the oil at that temperature will not carry them into a solution, while at that temperature, naphthalene is carried into a solution.

THE PROBLEM OF TECHNICAL EDUCATION.[1]

BY P. PETROVSKY.

From the contents of the paper and the character of the discussion it would seem to be the general opinion that the present system of technical education does not work well, and that there is something wrong with it. These conclusions are based on the fact that many college graduates do not succeed in actual engineering work, and that employers are not satisfied with the work of college graduates.

I leave entirely aside the subject of developing the character, and confine myself to the question of technical education proper, or in other words, the supplying to graduates the necessary amount of knowledge. A thorough mastery of the engineering sciences is not possible to everybody. The young man desiring to devote himself to the engineering profession must have some inborn capacity. At the present time many young men go to engineering colleges solely because they expect thereby to receive larger salaries, but some of them have no ability in engineering, and since in college they are not separated from the more able men they sooner or later graduate, and after graduation as a natural sequence start in actual engineering work, with the result that they are failures.

The man with an inborn technical character of mind, whether he has a college education or not, will love his work, not because it pays, but because in technical progress he witnesses the display of human genius and is proud to himself take an active part in the development of new methods. No amount of education can develop these necessary qualities in a man who is not born with them. Therefore the admission to college and the taking of courses should be arranged in such a manner as to prevent incapable men from graduating.

There prevails an opinion among students that the work of the engineering colleges is difficult. This is really not the case. The student has perhaps to spend more time in the laboratories, in working out problems, writing reports and drawing diagrams than the students in the general courses, but there is no real difficulty in the work of the engineering courses. Anybody can fulfill the requirements and be graduated, provided he is willing to sacrifice enough of his time.

The work done in college is not such as to make the students think. This is the main evil of the system. A great deal of the required work is purely mechanical and consists in obtaining a result by the use of ready-made formulae. Of course engineering graduates should know how to use handbooks and formulae, but this knowledge is only a little part of what they should know. The methods used in actual practice are often different from those taught in class, and only a small part of the so-called "practical" knowledge obtained in college can be applied in practical life. This, therefore, can not be the main aim of education. Knowledge of general principles, a thorough understanding why formulae are as they are and not different, in fact, the true philosophy of engineering, all these are needed as a proper preparation for the engineering profession.

Under the present system, if a student meets a theoretical difficulty he feels that it is not necessary for him to busy himself and overcome it. He knows that the formulae is given and he knows how to use it, and he believes this to be sufficient, but one might just as well explain the use of many formulae to an intelligent skilled laborer, expecting that he may as a result become an engineer. Since the present system does not test the reasoning power of the students they have no incentive to put stress on brain work and to spend their time in thinking.

All this means that the work of our engineering colleges must be made "really" difficult. The work done by any student in a good college must of necessity be difficult.

[1] Communicated Discussion on Paper by S. B. Charters Jr. and W. A. Hillebrand.

I would suggest three principal reforms in technical education.

1. Increase the entrance requirements in mathematics and establish good, strict mathematical courses for the first three years residence of the student. Mathematics is the foundation of every kind of engineering, and is absolutely indispensable. No amount of mathematics can be superfluous. Theory of functions and partial differential equations are just as necessary as high school algebra. A careful test of mathematical ability should be made during the first year, and all who fail to fulfill the requirements should be advised to drop engineering work and go into some other course or college. Of course this means an increase in the difficulties to be overcome by the students, but this is as it should be, because mastery of the engineering sciences cannot be made easy. The student should appreciate beforehand that the task is difficult and the goal not accessible for everybody.

2. The present system of early specialization must be abolished.

The engineer must know very well all branches of engineering, and he must know some one perfectly. This perfect knowledge of his specialty he can obtain only in actual practice. The college does not propose to make engineers, and nobody expects new graduates to be engineers at once, but the college must prepare the graduate for the possibility of such development. Under the present system a graduate in civil engineering knows nothing about electrical engineering, and a graduate in mechanical engineering knows very little about civil engineering, but true and real "engineering" is more universal than this, and progress in one line of engineering is possible only with progress in all other lines. If engineering graduates are to work not only for the salary for themselves and the profit of their employers, but are also to work for the progress of technical science. they must be broadly educated in all lines of engineering. Until this change is brought about America will lag behind Europe in scientific engineering.

3. Introduction of oral examinations. Under the present system of final examinations about 25 per cent of the term is wasted, and these final examinations add nothing to the knowledge of the students. They do not even furnish a reliable test of their scholarship. In place of these final examinations the student should be given every three or four weeks oral class examinations.

In order to hit a bull's-eye it is necessary to aim slightly above the center of the target, and similarly in order to acquire the proper amount of knowledge we must strive to be able to impart our knowledge to others. At the oral examination it is impossible for the student to dodge some difficult theoretical point. He must overcome it in his preparation, because he knows he will be summoned to the blackboard to explain this theoretical point to the class.

The probable objection to the reforms above indicated which may be urged is that it is impossible to increase the amount of work which can be accomplished by the students, but in reply I would say that many of the problems, reports and drawings required at the present may be well omitted without any loss whatsoever. Work at home should consist primarily of reading and thinking. A limited number of problems individually assigned to each student might be given during the term. With such conditions of instruction in vogue the number of lecture units might well be increased 50 per cent, which system is practically that in use in European technical and scientific universities at the present time. The introduction of such changes would result in giving the graduates really valuable theoretical preparation for their profession.

It is quite possible that such a system will greatly reduce the number of engineering graduates, but the result will be better, because the smaller number of graduates will give a much larger percentage of successful engineers.

POWER FACTOR CORRECTION.[1]

BY L. S. ODELL.

In these days a.c. power systems are becoming so common, and the attendant problems in power factor correction so well understood, that to those familiar with the subject, any further discussion of power factor correction by the use of the synchronous motor must seem superfluous. However, recent installations of these power systems has to some extent revived interest in an old subject, as is manifested by the inquiries received by manufacturers of electrical apparatus regarding the synchronous motor, its adaptability to the correction of power factor on systems already installed and the size and design of the motor required.

Whenever power is used from an a.c. line, whether it be through the medium of synchronous or induction motors or by means of a transformer, as is the case for lighting purposes, it is always found that the reading of the wattmeter, showing the power used, is less than the product of volts and amperes on the line. The percentage that the former is of the latter is the power factor. The energy component of the power carried by a line is the volt amperes x power factor. We have also to consider a wattless power component displaced 90 degrees in phase from the energy component, so that $P.F.^2+W.F.^2=1$ where W.F. is the factor, by which we multiply the volt amperes to give the wattless power component. In a power system these wattless power components are not registered on the customer's meter, nor do they directly necessitate any increase in power at the generating station. However, a low power factor on a system means that a current much greater than that required for real power consumption is being carried, necessitating greater line capacity, larger machines, etc., and increasing the losses due to inductance, capacity losses, friction, etc. On a light load these losses may become very large, compared with the load, giving a system of low efficiency.

Induction motors, when working, cause a lagging current. Transformers also constitute an inductive load, and create a lagging wattless component of power, but when used in connection with a lamp load, the reduction of power factor is not so serious. Now the wattless component of a synchronous motor, under certain conditions, leads the power component, so it is at once evident that synchronous and induction motors might be worked together on a system in such a way as to make the leading and lagging effects neutralize and create a power factor of practically unity.

Induction motors are the more common type in use for general purpose work, so that usually a synchronous motor, when put in, is employed to correct a loss power factor due to lagging currents caused by the former type of motors. Suppose this power factor is .8. Experiment shows that as the power factor is corrected more and more nearly to unity, the capacity of the synchronous motor required to make a further change becomes relatively much greater as, for example, if a motor of 100 k.v.a capacity were required to correct the power factor from .8 to .95, one of 200 k.v.a. capacity would probably be required to bring it up to unity. Hence it is not consistent with economy in first cost to install a motor large enough to completely correct the power factor of a system, as the last few per cent of correction are dearly paid for in the increased k.v.a. capacity required in the motor. The better practice is to install a motor large enough to bring the power factor to .90 or .95 when the system is fully loaded, while on light loads the capacity of the motor will be sufficient to raise the power factor still higher, and perhaps completely correct it.

The synchronous motor will do its work as a corrector of the power factor whether coupled to an external mechanical load or not. However, it is advisable to put it on such an external load if possible. Such a load will be represented in the motor by a power component in quadrature with the current used for power factor correction, giving a resultant load not much in excess of the correction load even with a considerable mechanical output. For example, in one case it was found that an external load, equal to 50 per cent of the correction load, could be carried with an increase in the required k.v.a. capacity of the motor of only 12 per cent.

The following example will serve to further illustrate the circumstances under which a synchronous motor may be installed. Suppose induction motors are now carrying a load of 800 kw., with a power factor of .8. It is desired to determine the capacity of a motor of the former type which will correct the power factor to .95 and carry a load of 200 kw.

Wattless current due to induction motor load at .8 power factor, $\sqrt{1-.8^2}\times{}^1/_{.8}\times800=600$ k.v.a.

Total wattless current due to load of 1,000 kw. at .95 power factor $=\sqrt{1-.95^2}\times{}^1/_{.95}\times1{,}000=336$ k.v.a.

Hence the synchronous motor must furish the difference between these two results, the former being the initial lagging component and the latter the lagging component after correction. Combining this difference of 264 k.v.a. with the machanical load of 200 k.v.a. in quadrature we have:

$\sqrt{264^2+200^2}=332$ k.v.a.=total capacity of the synchronous motor.

Then the power factor at which the synchronous motor will operate as $\frac{200}{332}=.6$ approximately.

Hence in above case a synchronous motor of 332 k.v.a. capacity must be installed, and the excitation so controlled that it will operate under a power factor of .6.

The reason for this adjustment of excitation is as follows: Such a motor when operating under any particular impressed voltage, sustains a constant magnetic flux, no matter what the exciting current may be. A lagging or leading induced armature current is set up, this induced current being such as, when combined with the field excitation, will give a constant magnetizing force. When the fields are over excited a leading current will flow in the armature, and hence a synchronous motor must always be over excited when used to correct a power factor which is held down by lagging currents. When operating a synchronous motor, as explained above, an increase in the field excitation

[1]Applied Science.

will increase the leading current it will draw from the line, while decreasing the field excitation will decrease this leading current until when this leading current falls to zero the motor is operating under unity power factor. A further decrease in excitation would cause the machine to draw a lagging current from the line, so that if necessary a synchronous motor could be used to correct power factors for either leading or lagging currents.

Certain important characteristics effect the suitability of a motor for this class of work. Any a.c. generator would operate as a synchronous motor, but used for correction of power factors held down by lagging currents, might not be satisfactory. These machines are over excited, and the excitation increases directly as the current, while the heating effects in the field coils increase as the square of the current. Hence machines of low frequency where the number of poles is small and which often give trouble by heating when used as generators, will not do, owing to the high temperature in the fields. A machine with a small air gap decreases the amount of excitation necessary. Also the weaker the armature, or in other words, the fewer the coils in it, and the lower the resistance of those coils, the greater will be the induced leading current for the same increase in field excitation. Hence the characteristics of a good machine for power factor correction are a large number of low resistance fields, a small air gap and a weak armature. Such a machine, however, is not likely to be satisfactory as a generator.

Throughout the country there are a great many induction motors operating on power factors of from .5 to .7, and in many cases power consumers are being penalized by the companies, who insist on a power factor of .9 to secure the lowest rates. The synchronous motor offers a means of correction of this difficulty. In many cases, however, the saving will not justify the expense entailed, especially where there is the employment of skilled labor to be reckoned on along with the installation. In other cases, where the load is taken off at only a short distance from the generator, the initial expense is again prohibitive, as the increased generator capacity is the only saving effected. However, on long transmission lines where a low power factor necessitates increased capacity of generators, step up and step down transformers and all other apparatus in the system there is no question as to the advisability of using some means to balance up the lagging and leading currents and hold the power factor as near unity as possible.

ELECTRIFICATION OF KONGO RAILWAY.

A study is being made of conditions on the Kongo River between Matadi and Leopoldville for obtaining power to electrify the railway between the two places operated by the Compagnie du Chemin de Fer du Kongo, whose headquarters are at 48 Rue de Namur, Brussels, Belgium. This railway is the connecting link between the Upper and Lower Kongo, and is about 250 miles in length. The river has numerous rapids and falls between the two places, from which it is expected to obtain the necessary power. Freight and passenger rates are at present high, accommodations inadequate, and two days are required to make the trip from Leopoldville to Matadi. A first class electric railway should change these conditions for the better and facilitate the development of the vast territory for which the Kongo River and this railway are the natural outlet.

WATER POWER IN BRITISH COLUMBIA.

Consul Frank C. Denison of Fernie reports that the first plant for the generation of electrical power by water in his district has been successfully inaugurated by the Bull River Electric Power Company at the Bull River Falls, 13 miles due west of Fernie. At this point a fall of 273 feet has been obtained by the construction of a flume 9000 feet long, which takes water from the river above the falls and returns it below. A head of 273 feet with a flow of 462 cubic feet of water per second is available. The flume, constructed of wood and built upon a rock foundation, is 30 feet wide by 7½ feet deep at the intake. The width is reduced to 16 feet within the first thousand feet, this width being kept to the end of the flume. The estimated horsepower that can be utilized is 12,600. The company is now preparing to install the penstock, which is to be of steel, 9 feet in diameter, and will rest upon bedrock the whole length, at an angle of 30 degrees. The foot of the stock will rest upon a natural bedrock, and a T-shaped cross pipe will be placed at the end of the stock in which the wheels will be placed; three wheels of 4200 horsepower each will be utilized as the demand for power develops. The company expects to sell power to the city of Fernie on the east and Cranbrook to the west, and to many of the mining plants within the territory to be reached from its central position. Within a radius of 30 miles there are now in operation steam plants with an aggregate of 23,650 horsepower. Some of this power is used by sawmills, which will continue to employ steam on account of the cheapness of the mill waste used as fuel, but it is expected that many mining and smelting plants within reach of this new plant will discard steam for electrical power. Cranbrook is only 17 miles due west of the plant and Fernie 13 miles east. The company expects to deliver power to the mines at Moyie at a rate that will pay, and as far east as Frank, Alberta. Within this radius there is available undeveloped water power to the extent of 30,000 horsepower, the greatest single power being at Elko, on the Elk River, 20 miles south of Fernie. This estimate does not include the possible power to be developed by damming the different mountain streams in their courses, but is confined to the power available at the various natural falls along the courses of the larger streams. By the expenditure of capital the quantity could be easily doubled.

Examination for Assistant Physicist, Bureau of Standards, is announced by the United States Civil Service Commission on February 8, 1911, to fill vacancies as they may occur in the positions of laboratory assistant (in physics) and assistant physicist in the Bureau of Standards, Department of Commerce and Labor, at salaries varying from $900 to $1200 per annum for laboratory assistant and from $1400 to $1800 per annum for assistant physicist.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company
E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.
DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

We wish you a Happy New Year; may your power factor increase and your load factor never grow less.

Retrospective

Taking stock of the Pacific Coast electrical market for 1910 we find that supply and demand have kept close pace and that both have experienced a healthy increase. Many new electric power plants have been brought into service and many new consumers have been put on the lines. Increased current consumption has induced added purchases of supplies and equipment, so that the dealer and the contractor has been as prosperous as the current seller. Present indications point to even better conditions during the year to come, for electricity is daily becoming more generally used.

More noteworthy than mere increase in consumption is the greater miscellanity of uses to which electric energy is being successfully applied, especially in lessening labor for the Western farmer and miner. By means of electrical irrigation thousands of acres of hitherto arid lands, particularly in the Northwest, have been brought under cultivation and the farmers furnished with cheap power. Electrical mine equipment has reduced the cost of operations so that it is now possible to work ores of lower grade than were formerly profitable; this also with much less danger to life. Electric pumping of oil was first employed in California this year and should greatly augment the present annual production of eighty million barrels. In metallurgical work the Cottrell process for the electrical precipitation of smelter fumes has reanimated the old industry of copper mining, while the electric smelting of iron ore has established a new and needed one. With cheap oil fuel and cheaper as well as better iron, the Pacific Coast bids fair to become a manufacturing center as well as a producer of raw material.

Of the new energy sources, the largest is the 15,000 kilovolt-ampere steam turbo-generator of the City Electric Company of San Francisco. Of the numerous new incorporations, those represented by H. M. Byllesby & Company of Chicago, the Pacific Light and Power Company in the Northwest and the Western States Gas and Electric Company in California, are the largest. Power is now being transmitted at one hundred thousand volts over five Western transmission lines. This year also marked the first Pacific Coast national meeting of the American Institute of Electrical Engineers and the formation of a local branch of the American Society of Mechanical Engineers. The first electric shows to be held in the West were those at San Francisco and Denver. The rapid adoption of the electric vehicle and of the new types of electric lights has been characteristic throughout the coast, though not confined to this section as are most of the big things already mentioned in this brief catalogue of Western achievements.

PERSONALS.

C. L. Cory spent the past week at Los Angeles on engineering business.

W. J. Marland is with the United Light & Power Company as contracting agent.

F. M. Ray, of Foucar, Ray & Simon, Inc., has gone to New York City on business.

J. G. De Remer, assistant general manager of the United Light & Power Company, is at Los Angeles.

H. F. Keyes, manager of the Sacramento Natural Gas Company, was a San Francisco visitor last week.

W. H. P. Hill, manager of the Monterey County Electric Gas & Electric Company was at San Francisco last Monday.

H. F. Jackson, manager of the Sierra & San Francisco Power Company, returned home from a trip to New York last week.

H. E. Merrithew, of the office organization of the Fort Wayne Electric Works, is paying a visit to the firm's San Francisco branch office.

D. C. Henny, construction engineer U. S. reclamation service, has opened an office as consulting hydraulic engineer in the Spaulding building, Portland, Ore.

B. C. Carroll, general agent of the Pacific Telephone & Telegraph Company, returned to his San Francisco office last Tuesday after making a tour of the Pacific Northwest.

E. V. D. Johnson, general manager of the Northern California Power Company, returned to his headquarters at Redding last Tuesday, after spending Christmas at San Francisco.

W. W. Hanscom, consulting electrical engineer, San Francisco, has completed his work on the electrical installation for the Columbia Steel Company and is now working on the equipment of the new Examiner building.

Henry T. Scott, president of the Pacific Telephone & Telegraph Company, returned to San Francisco last week from Washington, D. C., where he spent some time "boosting" for the Panama-Pacific International Exposition of 1915.

L. S. Adams, naval constructor, with the U. S. Navy, passed through San Francisco, en route from the navy yard at Cavite, P. I., to Schenectady, N. Y., where he will inspect work done for the navy by the General Electric Company.

C. E. Groesbeck, second vice-president of H. M. Byllesby & Co., of Chicago, sailed last week for Japan. He will spend several months in foreign travel by way of recreation, after the strain of closing numerous deals for the purchase of electric power plants during the past year.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast branch, returned to San Francisco last Thursday after inspecting the Pacific Light & Power Company's new electric power plant at Redondo. The large steam turbines and other apparatus, which have been in successful operation for the past two weeks, were installed by his company.

Paul Shoup, vice-president of the Pacific Electric Railway Company and assistant general manager in charge of electric lines of the Southern Pacific Company, now makes his headquarters at Los Angeles. E. E. Calvin, general manager of the Southern Pacific, spent the past week at Los Angeles advising with Paul Shoup regarding the reorganization of the administrative and office force of the department of electric transportation.

A. C. Sands of Tacoma, Wash., aged 60 years, died in Seattle last week of a nervous breakdown which had extended over a period of two years. He came to Tacoma in 1884 and entered the service of the Sunset Telephone Company as local manager, rising to the position of district manager for Western Washington. He had charge of the construction of the telephone lines of the company in Alaska in 1898. Failing health compelled his retirement last April. He is survived by a widow and two brothers.

TRADE NOTES.

The Standard American Dredging Company of San Francisco has just ordered a 700 h.p. alternating current induction motor from the Westinghouse Electric & Manufacturing Company.

At the San Francisco factory of the Pelton Water Wheel Company, three 4000-h.p., 600-r.p.m., Pelton-Francis turbines which are to be operated under 420 ft. head by the American Smelting & Refining Company are rapidly nearing completion and will be shipped in the near future to Chile. Several of the manufacturing company's staff are now on the ground preparing to install the steel pipe line that is also to be furnished by this company.

On and after January 1st, the sales offices of the Pelton Water Wheel Company of San Francisco, which were formerly in the Monadnock building, will be consolidated with the factory offices at Nineteenth and Harrison streets. The change is made in order to facilitate the turning out of work by preventing the loss of time caused by the separation of the departments. As the drafting rooms, and the accountants' and sales offices are now under one roof, it is expected that business will be carried on more expeditiously throughout.

The Technical Department of the Humboldt Evening School will open for the spring term on Tuesday, January 3, 1911. Classes will continue instruction and be open for new students at that time in architectural and mechanical drawing and the necessary mathematics also in theoretical surveying, mechanics, physics, chemistry and steel square. The work of this school is especially designed for young men engaged in industrial branches of the building and iron trades. A special class in structural engineering has recently been started for architectural and engineering draftsmen and apprentices as well as those engaged in outside steel, wood and concrete construction. Lectures on technical subjects by leading professional men engaged in various specialties will be given during the school year to which the public are invited.

NEW CATALOGUES.

"Heat as the Family Doctor" is the title of an interesting pamphlet from H. W. Johns-Manville Company telling of the curative powers of the J-M Electrotherm.

ERRATA.

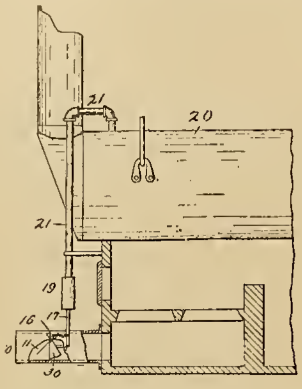
In the article "Starting Induction Motors" in our issue of Dec. 24, 1910, an unfortunate transposition of type obscures the author's meaning in the last column of page 551. Lines 5-19 should be inserted before the last three lines of next to the last paragraph.

JOVIAN DINNER AND REJUVENATION IN CHICAGO.

A Rejuvenation of the Sons of Jove will be held in Chicago on the evening of Friday, January 20, 1911. This rejuvenation will form a part of one of the special days at the Electrical Show, which will be held in Chicago from January 7 to 21. Active committees on membership, dinner and publicity have been organized, and the work is being participated in by the most influential and energetic men of the electrical fraternity of Chicago. It is proposed to initiate a large class of candidates and the beautiful ritual of the Sons of Jove will be carried through in a most impressive manner. Following the initiation there will be a Jovian dinner.

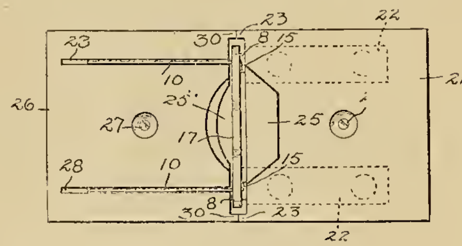
PATENTS

979,069. **Draft-Regulator,** Frank M. Heath, Portland, Oregon. In a draft regulator, the combination of two dampers co-operating with the same flue or passage, one being movable toward and from the other to vary the size of the draft



passage, automatic heat-operated means for causing movement of one of said dampers to a predetermined position with reference to the flue or passage, and a device actuated by said heat-operated means adapted for controlling the movements of the other damper subsequently.

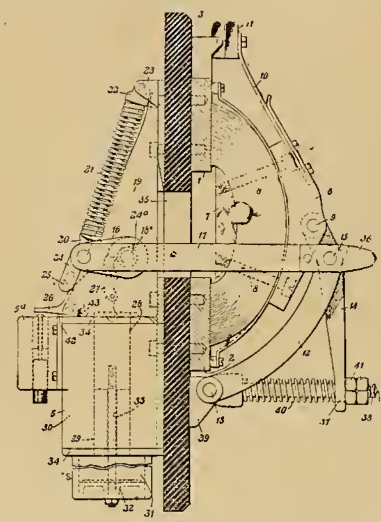
979,050. **Electric Switch.** John A. Ward, Spokane, Wash. The combination with a base member, of terminal members carried thereon, parallel switch blades pivoted thereon, terminal members spaced from the first named members and adapted to receive said blades therein, an insulating grip bar carried upon the free ends of said switch blades. said bar having a central recessed enlargement adapted for manual engagement to operate the switch, an insulating cover member engaged over said base member and covering said first named terminal members and having parallel narrow slots therein adapted to allow close movement of the switch blades therein, and stopping adjacent said cross bar, a second cover member disposed oppositely of the cross bar, each of said



cover members having extensions meeting at the opposite ends of said cross bar and having opposed finger receiving recesses therein on opposite sides of the cross bar and stopping short of the second named terminal members, said cover members projecting outwardly a spaced distance beyond the outer ends of said second named terminal members, and beyond the central extension of said cross bar to prevent casual engagement and operation of the switch, and to prevent contact of parts of the person with the conducting portions of the switch when closed.

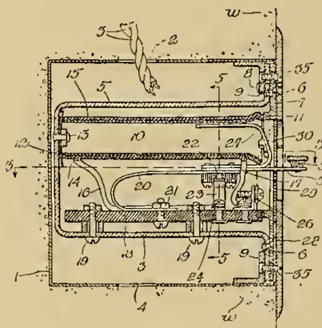
13,184 (re-issue). **Meter.** Robert Lee Rickman, Vancouver, British Columbia, Canada, assignor of one-half to Samuel Kenrick Champion, Vancouver, British Columbia, Canada. In a meter, in combination, a base, a driven member supported thereby, registering means mounted upon said base, an intermediate mechanism for transmitting motion from said driven member to said registering means, said mechanism comprising a member adapted to be removed and to be replaced by a member of a different size, and means for varying the position of said registering means with respect to said base, whereby to compensate for the difference in diameter of said inserted gear with respect to the replaced gear.

978,882. **Circuit-Breaker.** Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. A circuit interrupter comprising an insulating slab or plate having an aperture, stationary contact members secured to one surface of the plate at opposite sides of the aperture, movable bridging contact members, operating



means on the opposite side of the plate from the contact members, connecting links extending through the aperture in the plate for establishing an operative connection between the movable contact members and the operating means, and a tension spring for assisting the initial action and for opposing the final action of the operating means in closing the circuit breaker.

978.980. **Flush Curling-Iron Heater.** James I. Ayer, Cambridge, and Horace B. Gale, Natick, Mass., assignors to Simplex Electric Heating Company. A curling iron heater, comprising a face plate adapted to occupy a position flush with the face of the wall, a wall box inclosing the operative parts of said heater adapted to be set permanently into the wall behind



said face plate, said face plate having an opening for the insertion of a curling iron, a tubular electric heater supported behind said face plate within said wall box for receiving said curling iron, a switch also within said box for controlling the current supply to said heater, and a movable gate behind said face plate for normally closing the opening in the face plate.

INDUSTRIAL

STARTING DEVICE FOR POLYPHASE INDUCTION MOTORS.

The type of motor most widely used for a great variety of industrial purposes, namely, the squirrel-cage type, has one very undesirable feature—it requires a heavy starting current. It is thus essential that the question of the starting device be given careful consideration. Such a device is installed for the purpose of restricting the starting current to such value that it will not cause undue fluctuation of the line voltage, or surging, and also to accelerate the motor evenly from start to full running speed. A simple, efficient, and reliable starting device for alternating-current motors is shown herewith. Fig. 1 and 2 show the general appearance of an Allen-Bradley three-phase compensated starting switch. This starter consists essentially of a three-pole knife switch and an Allen-Bradley compressible resistor connected in shunt across the gap of the switch in each phase, together with suitable mechanism for compressing these resistors and decreasing their resistance.

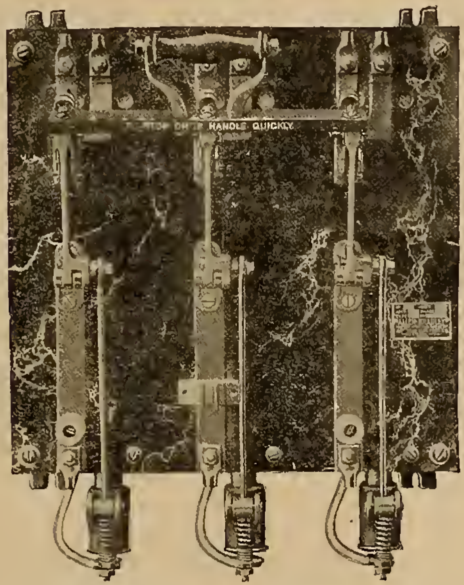


Fig. 1. Front View.

The resistors used in this starter consist of a column of specially prepared graphite discs enclosed in an insulated steel tube, the resistance being varied by varying the compression on the column of discs,, maximum resistance being obtained with minimum pressure and minimum resistance with maximum pressure.

Fig. 1 shows the front view of the motor starter with the lever up or in the running position. The side elevation, Fig. 2, shows the general arrangement of the resistors which are placed at the rear of the slate panel, the perforated metal casing being removed.

The starting operation is as follows: The lever is brought up from the "off" position to a horizontal position, raising the resistor by means of the eccentric and closing the circuit through maximum resistance, which in standard practice with this apparatus allows about 50 per cent of the normal running current to flow. A continued movement of the switch handle compresses the discs, cutting out the resistance gradually until the motor comes up to speed, after which the lever is thrown to the full "on" position, the resistors being short-circuited by the switch blades and clips at a drop in potential of not over 10 per cent of the full voltage. In stopping the motor, the lever is pulled back to the "off" position, as with any other switch, the construction of the mechanism being such that the lever will remain only in the full speed position, or at the "off" position. The circuit being made and broken within the resistance container, the air is excluded and any tendency to arcing reduced to a minimum.

These starters have been subjected to numerous tests, and under the most severe operating conditions have shown exceptional results.

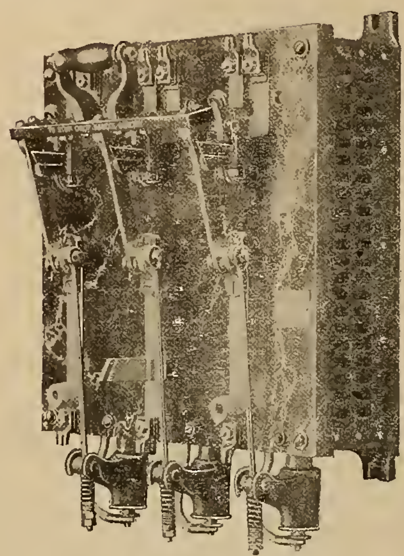


Fig. 2. Side View.

In comparative tests made with a compensated starting switch and auto-starter, operating a 10 h.p., 440-volt, three-phase, squirrel-cage induction motor, the following results were noted: The motor was started under a moderate load of line shafting and with a small blower and pump belted directly to the shafting. With the auto-starter, the motor required about 60 amp. per leg to start, the voltage impressed on the motor terminals being about 200, the line voltage dropping from 410 to 375. With the Allen-Bradley starter the motor was accelerated much more evenly and with less slippage of belts, requiring from 25 amp. to 40 amp. per leg, depending on the time taken in bringing the motor to full speed, 175 volts impressed on the motor terminals, the line voltage dropping from 410 to 395.

The advantages claimed for this form of starting device for induction motors are as follows: Low starting current; elimination of line disturbance; more even and gradual acceleration of motor; light weight; no interruption of the circuit during starting period, and simplicity of construction. All parts on the face of the panel are made of copper in accordance with standard switch practice. Extra terminals are provided for starting fuses, these terminals being disconnected in the running position.

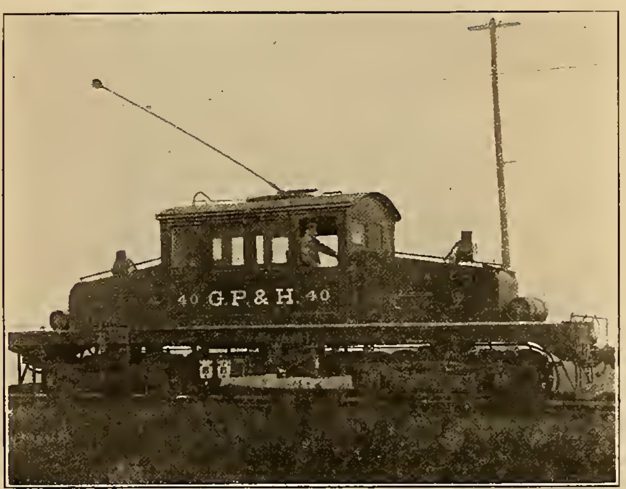
This rheostat is also arranged as a secondary starter for slip-ring type motors. The apparatus is manufactured in sizes ranging from 5 h.p. to 35 h.p., inclusive, by the American Electric Fuse Company, Muskegon, Mich.; San Francisco office, 143 Second street.

F. C. Perkins, formerly manager of the field department of the Reynolds Electric Company, has opened offices in the Bailey building, Seattle, as manager of the Perkins Electric Company, and will buy, sell and exchange electrical machinery.

A NEW FREIGHT LOCOMOTIVE.

The accompanying illustration shows the new electric locomotive recently purchased by the Galt, Preston & Hespeler Street Railway Company, Ltd.., of Ontario, Canada. This company operates some 30 cars on a standard gauge interurban line, 21 miles in length, connecting the above points with the towns of Freeport, Centreville, Berlin and Waterloo. The power station and repair shops are at Preston. The railway traverses a farming country and does a thriving business in both local and through passenger and freight business.

Several years since the G. P. & H. Street Railway Co. purchased from the Westinghouse Electric & Manufacturing Company a quadruple equipment consisting of four No. 93-A direct current motors with a nominal rating of 60 h.p. each at 600 volts, for a locomotive similar to the one shown, but of smaller capacity. Its operation has been eminently satisfactory in every respect and the recent order for a larger



A New Freight Locomotive

locomotive of the same general characteristics argues strongly for the excellence of design and low maintenance charges of this type of slow speed freight locomotive.

Much has been said about the impracticability of electric freight haulage but the steadily increasing sales of slow speed electric locomotives especially designed for freight service and the invariably favorable reports of operation is affirmative evidence of the most forceful nature. There are many interurban electric roads tapping sparsely settled farming districts and outlying towns not favorably located on main steam trunk lines, which could develop a highly profitable express and freight traffic with the aid of a suitable electric locomotive.

The G. P. & H. locomotive shown in the accompanying cut was built by the Baldwin Locomotive Works and the complete electrical equipment furnished by the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa. It is designed for the standard 4 ft. 8½ in. gauge and provided with double swivel trucks. The wheel base is 29 feet and the over-all dimension 36 ft. and it weighs complete, 100,000 pounds. The gear ratio of 16.57 gives a normal speed of 8.25 m.p.h. at which speed a tractive effort of 18,220 pounds is developed. The maximum tractive effort is 25,000 pounds. The locomotive carries a quadruple equipment consisting of four No. 308-B2 interpole, direct-current railway motors having a nominal rating of 100-h.p. each, or a total of 400 h.p. at 600 volts. These motors are fitted with special windings adapting them particularly for slow speed locomotive service. Standard nose suspension is used.

The well known Westinghouse unit switch control was provided, because of its simplicity and uniform positive operation. Two master controllers are supplied, one in each end of the cab. These controllers carry only the small current from a storage battery, for exciting the electro-magnetically actuated needle valve which admits air at 70 lb. pressure to the air cylinders of the unit switch. The action of each switch is therefore positive and independent of fluctuations of the line voltage. It frequently happens on interurban and stub-end lines that the voltage at points far distant from trolley feeders is as low as 200 volts when the motors are in operation. Under such extreme or even less severe conditions solenoid operated contactors, depending upon the line voltage for their contact pressure, are apt to give trouble due to looseness and arcing at the contacts. With air operated switches all such possibilities are eliminated and the greatest reliability under all conditions assured.

APPLICATION OF FAN MOTORS FOR WINTER USE.

It is the popular opinion that the range of usefulness of the electric fan motor is limited to the summer months and that its sole utility lies in its application as a means of reducing the temperature of a room or an office. This is not true, however, and slowly but surely the public is beginning to understand that the usefulness of the fan motor is by no means confined to the hot days of summer, and that paradoxical as it may seem the electric fan blows hot and cold; and incidentally while it is blowing hot it cuts the fuel bill.

Following are a few of the more important applications of the fan motor to winter use:

The efficiency of the hot air heating system may be greatly increased by placing a fan motor in the cold air box to force the air through the registers to all parts of the

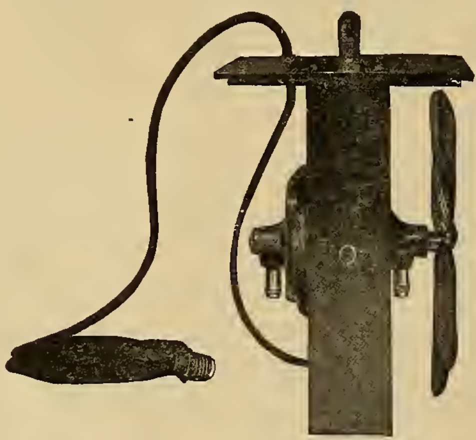


Fig. 1. Exhaust Fan Blower for Furnace.

house. On particularly cold days when the wind is so strong that it forces the air through the furnace into the rooms without having become heated, a fan motor placed in the cold air box, after having closed the slide which permits air to come in from the outside and opening the slide which lets the air in from the cellar, will cause an appreciable rise in the temperature of the room, without making any increase in fuel consumption.

As is very often the case, the house contains a room or rooms which under certain conditions are difficult to heat. This difference can be overcome by placing a fan motor in front of the hot air register or over it in case the register is located in the floor. This plan will prove more efficient if the register and fan motor are covered by a box or hood of some kind which will cause the fan motor to draw air from the pipe only, and not from the room.

In a house heated by hot air or steam, increased radiation of heat and consequently a warmer room may be obtained by placing a fan at the end or back of the radiator.

Another manner in which the fan motor may be used to advantage in winter is to prevent the accumulation of frost

on show windows of stores. The air from the fan motor directed against the glass of the window will keep it practically free from frost. This application of the motor is a

Fig. 2. Exhaust Fan Blower Installed in Furnace.

boon to merchants who have, heretofore, during the cold weather, lost practically all the advantage which their window display accomplishes.

TRAIN DISPATCHING TELEPHONES PROVE THEIR USEFULNESS.

The value of the telephone method of dispatching trains, which has superseded the old familiar telegraph on many of the largest railroads of the country, has been demonstrated by the behavior of this system on the Pere Marquette during recent sleet storms. The telegraph was put out of commission, but the telephone circuit worked continuously and received many words of praise from the railroad people. Telephones and selectors furnished by the Western Electric Company have been placed in service along 136 miles of this road, between Saginaw, Mich., and Toledo, Ohio.

The telephones have been installed at thirty way-stations and four sidings. The service on this division will be watched with interest, as the traffic on the Toledo Division is unusually heavy. Several times in the past the railway has found it necessary to cut the telegraph train wire into two sections in order to handle the traffic, but it is believed that the telephone equipment will enable the work to be handled entirely with one circuit.

The Michigan Central has recently installed train dispatching telephone circuits between Jackson, Michigan and Niles, Ohio, 105 miles, with 34 telephone stations; between Jackson and Bay City, Michigan, 115 miles, with 23 stations, and Jackson and Grand Rapids, Michigan, 94 miles, with 21 stations. Equipment has been ordered for a telephone line between Windsor and St. Thomas, Ontario, Canada, 111 miles, with 20 stations. Plans have been made for the installation of a number of other circuits during the coming year.

WESTINGHOUSE DEVELOPMENTS DURING 1910.

Metallic Flame Arc.

A notable accomplishment in the illumination field was the development of a thoroughly dependable and exceedingly efficient metallic flame arc lamp for operating on multiple circuits. Types have been developed for straight multiple and for multiple-series operation. The negative electrode pencils of metallic oxide are arranged above the positive, metallic buttons, in the Westinghouse lamps. Through this electrode arrangement a maximum amount of light is projected in useful directions.

Wire Type Lamp.

Probably the most notable improvement in electric lighting is the Westinghouse wire type lamp. The wire type lamp was brought to the attention of the public for the first time at the St. Louis convention of the National Electric Light Association; the announcement of the perfection of the methods of manufacturing a single filament lamp created quite a sensation. The wire type lamp rapidly increased in popularity and only six months after its advent it became necessary to increase the manufacturing facilities of the Westinghouse Lamp Company 10,000 lamps per day. The new plant of the Westinghouse Lamp Company is located at 510 to 532 West Twenty-third street, New York City, and is to manufacture exclusively 25, 40 and 60 watt wire type tungsten lamps. The lamp being constructed by an entirely new process it was necessary to develop and manufacture new machinery for the equipment of this plant, which machinery is entirely of American design. The starting of the plant marked the separation of American apparatus from the modified European apparatus, which has heretofore been made to fit American conditions. The factory itself is organized on new lines, which are quite a departure of lamp manufacture in that it is made up of a number of individual factories each independent of the other and all operating in the one plant. The wire type lamp is made with a single filament extending from one leading-in wire to the other with a positive electrical connection between the filament and the leading-in wires. The joint is protected by wrapping the filament around the leading-in wires; this insures flexibility and eliminates points of rigid contact in the lamp. This construction and the improvements in the method of making the filament do away with the fragility that has been present in the ordinary tungsten lamp.

Heating Apparatus.

Westinghouse heating apparatus is being made with only hermetically enclosed resistors. All new devices that were developed in 1910, the resistors are sealed within welded metal jackets and the heaters can readily be removed for cleaning.

Circuit Breakers.

The objection frequently offered to the use of circuit-breakers for motor control has been the lack of any time element in their operation or the fact that they open the circuit instantaneously upon the occurrence of an overload. This fact renders it impossible to set the breaker so that it will protect the motor under operating conditions and at the same time permit the momentary rush of current at starting. A circuit-breaker, therefore, that possesses, in addition to the inherent advantages, a time element similar to that of a fuse without its attendant disadvantages, fills a long felt want in industrial motor applications. Such a device is embodied in the modification of the wall mounting type H oil circuit-breaker originally designed for low-voltage circuits. The inverse time element attachment, which was designed by a well-known engineer, is simple, compact and mounted within the oil tank. It permits the breaker to remain closed during a momentary overload by retarding the movement of the overload trip coil plungers in direct proportion to the extent of the overload. In other words, the time required for the breaker to open varies inversely as the magnitude of the current. This line has been extended to include a switchboard mounting breaker for use on 2500 volt circuits.

Distributing Transformers.

During the year the Westinghouse Electric & Manufacturing Company developed and placed on the market a complete line of distributing transformers for 6600, 11,000 and 16,500 volts. This line, known as the type "SK," parallels the type "S" low-voltage transformers put out by this company in recent years and is meeting with the same success. The new design has taken advantage of the recent developments in silicon steel, improved insulating materials, and other important factors.

Feeder Regulators.

Improvements made in the induction type of feeder regulators by the Westinghouse Electric & Manufacturing Company during the year have resulted in the complete elimination of the chief objection formerly held to regulators of the single-phase type, namely, vibration; the new skeleton frame construction for the stationary element and the use of corrugated sheet iron tanks. All of the accessories for automatic operation have been thoroughly redesigned for long life and minimum attention.

Meters.

In their indicating, recording, portable and watthour meters the Westinghouse Electric & Manufacturing Company have continued the developments pushed forward during past years. Both their alternating current and their direct current watthour meters have been improved with respect to the methods of adjustment and permanence of accuracy. The graphic meters have had improvements in the method of winding the paper feed, and to the already complete line of portable meters has been added a line of millivolt shunts. The switchboard meters have been further standardized and harmonized in appearance and a line of manganin shunts has been added during the year.

Motors.

The developments in motor design during the past twelve months have resulted in the standardization of motors for several important industries. Before a manufacturer can profitably develop a line of motors adapted to the peculiar needs of a given industry there must be sufficient interest in electrical power among the manufacturers in that line to indicate a reasonable demand for the motors when built. Previous to the development of special motors, it is necessary to try standard motors under the conditions to be met and determine wherein they are deficient. The Westinghouse Company has been making very complete investigations in several industries and has developed new types of motors for textile mills, for steel and cement mills, for elevators, for hoists, cranes and railway turntables, and for electrically operated vehicles.

For textile mills a squirrel cage polyphase induction motor must be used and to make possible the thoroughly satisfactory operation of the machines when individually driven standard motors cannot be used. The motors must be absolutely dust-proof because the lint of "fly" in a textile mill will get into the bearings of a standard motor if placed near the floor level and drain out the oil; and in addition the fly will accumulate in the ventilating ducts and finally plug them, acting like a blanket to the motor. Hence, the textile motors have been made without ventilating ducts of any sort and yet are designed to run cool. The bearings have also been made dust-proof and have no openings through which dust or fly can penetrate.

The starting characteristics required particular investigation to secure a motor capable of starting the load, also of operating with high efficiency at its average load. The load conditions of looms, spinning frames, warpers, pickers, dye-house machinery, hydro-extractors, etc., were investigated and each size of motor was specially designed for each class of service.

For steel mills, cement mills and brick yards where the service conditions are most severe a line of squirrel cage polyphase induction motors has been built of more rugged characteristics, both electrical and mechanical, than have characterized any similar motors. Due to the class of labor employed and the necessity of continuity of the work there is little possibility of sparing the machinery from hard knocks. Hence great mechanical strength and extreme simplicity characterize the motors that can satisfactorily meet these conditions; in fact the motors are capable of standing an enormous amount of abuse, and will operate for long periods without attention. The Westinghouse type MS motor is the first squirrel cage induction motor designed especially for mill service.

Because of the difficulties of designing and building a satisfactory alternating current motor for crane service it has been considered necessary in the past to use direct current motors almost exclusively for such service. Considerable expense has sometimes been incurred to install direct current apparatus for the cranes only when all the other machines were driven by alternating current motors.

The new type MW induction motor with wound secondary has just been developed with particularly high torque to fit it for such service. The motor mechanically is similar to the type MS motor with the changes necessary for the phase wound secondary. The electrical characteristics enable the motor to start very heavy loads and lift them at a good speed without taking an excessive current. This permits the small adjustments so necessary in the handling of a crane, without destructive sparking in the control apparatus.

In all induction motors previously built the armatures have been of large diameter and small length as compared with direct current motors of similar capacities, and hence the larger flywheel effects have made the motors less desirable for reversing service. The MW motor armatures are much longer and of smaller diameters, very closely resembling direct curent armatures in their dimensions, and thus the flywheel effects are made so low that these motors are particularly adapted to reversing service.

Owing to the similarity of the services these motors are as well fitted for hoists, elevators, railway turntables and transfer tables, draw bridges and roller lift bridges as for cranes. The simplicity of structure and the absence of complicated wearing parts make these motors peculiarly desirable for severe duty.

For elevator service a modification of the squirrel cage type MS motor has been developed which gives remarkable service. The end rings are designed with special high resistance to give approximately 20 per cent drop in speed from no load to full load, thus not only limiting the starting current, but also increasing the starting torque. This use of the squirrel cage motor materially simplifies the control and provides a motor which is free from any possible wear except in the bearings.

For electric vehicles a line of motors has been developed after a study of the conditions imposed by this service and a careful consideration of each element of the design. These motors are very strong and will successfully withstand the hard usage to which they are subjected. They are very efficient and have a high output per unit of weight. No fuses or other protective devices are required as the motors will take the full current of the battery for which they are designed. There is therefore no danger of opening the circuit in times of emergency. The frames are entirely enclosed and are waterproof. The brushes and commutator are, however, readily accessible for inspection, and any part can be readily removed in case of necessity.

Thus the entire trend of the developments in motors in the past year has been toward the production of new types of motors already built, to suit the requirements of special industries, thus securing greater advantages in the use of electrical power than are possible from general service motors.

NEWS NOTES

INCORPORATIONS.

CORCORAN, CAL.—The Alpaugh Telephone Company has been incorporated by business men of this city with a capital stock of $1500.

SANTA ROSA, CAL.—The Sonoma Valley Water, Light & Heat Company has been incorporated by E. M. and Edna L. Hoen, L. L., L. C. and Mabel Lewis, with a capital stock of $100,000.

LOS ANGELES, CAL.—The Southern Counties Gas Company of California has been incorporated by C. S. Forney, J. H. Badger. R. B. Wheeler, W. A. White and others with a capital stock of $75,000.

SAN FRANCISCO, CAL.—The Union Water Company of California has been incorporated by Alfred D. Plaw, William T. Barnett, E. D. Madison, Platt Kent and V. W. Vincent with a capital stock of $5,000,000.

SAN FRANCISCO, CAL.—The Red Cross Germ Proof Telephone Glass Mouthpiece Company has been incorporated by M. M. Morris, G. W. Merrill, H. H. Davis, G. E. Murphy and Maurice Summerfield, with a capital stock of $500,000.

BOISE, IDAHO.—The Boise Power. Light & Traction Company has been incorporated for $1,000,000 and is making preparations for the construction of a power plant on the Payette River to develop 5000 h.p., and cost $500,000. It is understood that the Telluride Power Company is preparing to spend several million dollars in the completion of its Idaho plans. The main power plant of the company will be constructed at the confluence of the Malad and Snake rivers to furnish 10,000 h.p. to run east and west across South Idaho. The Great Shoshone Falls Light & Power Company, with a plant on the Malad River at Salmon Falls, is arranging to run a line west through southern Idaho to meet competition of the Telluride Company at this place.

SAN FRANCISCO, CAL.—The Poulsen Wireless Company, composed of local capitalists, has filed articles of incorporation in Arizona, with a capital stock of $25,000,000 to exploit in the United States the wireless telegraph and telephone patents of Valdemar Poulsen of Copenhagen. Beach Thompson is president. E. W. Hopkins, George A. Pope. Howard P. Veeder, J. Henry Meyer, S. E. Slade, Charles D. Marx and C. F. Elwell, are among the incorporators. It is stated that the company would not be ready to enter the commercial field for some time. Its work at present, it is said, consisted of a series of experiments and tests. Communication, both by wireless telegraphy and wireless telephone, has been established between San Francisco and Stockton. The local station has been established at the beach.

TRANSMISSION.

PORTLAND, ORE.—The Mt. Hood Railway & Power Company has purchased a site on the East Side fronting on the Willamette river and has let a contract for an auxiliary power plant to Chas. C. Moore & Co., of San Francisco.

GROVELAND, CAL.—The entire holdings of the Tuolumne River Power Company have been sold to a syndicate of capitalists. Lester R. Wiley retains his interest in the new combination and will remain as manager. The new owners will begin development work at once.

NORTH YAKIMA, WASH.—Approximately $2,000,000 will be expended in extensions of lines and services by the Pacific Power & Light Company in the valleys of the Yakima next year. George Arrowsmith, local superintendent, announces the latest improvement planned is the extension of a high tension power wire from the Naches generating plant to the Richland District.

SILVER CITY, N. M.—The Gila River Power Company has been granted rights for the water of the Gila River in Western Grant County. The power company plans to develop 15,000 horsepower.

SPIRIT LAKE, IDAHO.—The Washington Water Power Company has established a camp one mile east of this place and will begin active work on the high tension power lines from Post Falls to Newport.

DIERENGER, WASH.—The Pacific Power Company has awarded a contract to the Allis-Chalmers Company, Milwaukee. Wis., to furnish two 24,000-h.p. high pressure Francis turbines for the power house at Lake Tapps project.

AMERICAN FALLS, IDAHO.—The Idaho Consolidated Power Company will develop 30,000 additional h.p. during the coming year, by building a new power station, which will constitute the main plant of the system, as projected several years ago. Authority for the announcement that the plant will be built the coming year comes from Governor Brady, who controls all the stock of the company.

RENO, NEV.—The Truckee River General Electric Company, of which J. B. Lukes is the local manager, has completed all its surveys and drawings for the building of a new power plant and has let some of the contracts. It will first build a big dam across the Truckee River near the Reno Country Club, as heretofore stated, and at a point a short distance east of Verdi will build a new power-house to generate 3000 h.p. This power will be used for the smelter at Mason City and Waubuska and for the operation of the mines at Yerington.

SAN JACINTO, CAL.—A reservoir site has been purchased by the Ramona Power Company, below Idyllwild. The company has obtained rights for power purposes to practically all the water in the north and south forks of Strawberry Creek, and the waters of these streams will be piped from a point as high up the canyons as possible in order to obtain a maximum drop down to the power-house, to be located in San Jacinto Canyon near the foot of the mountain. After passing through the power-house the waters will be returned to their natural sources, where the water is already owned for irrigation purposes.

TRANSPORTATION.

LONG BEACH, CAL.—The proposed Signal Hill trolley line from Zaferia Junction to the summit of Signal hill, is assured. Money for building the line has been subscribed. The line will cost $100,000.

HAYWARDS, CAL.—The new street railroad franchise from Front street at the depot through C to Watkins and B to the town limits that was applied for by I. B. Parsons, has been read and the clerk has been instructed to advertise for bids.

SAN ANDREAS, CAL.—The Board of Supervisors has received an application from Stanley D. Herbert for a franchise, right, privilege and permission to erect, construct and maintain a broad or narrow gauge track or railway and necessary bridges, in the town of Wallace, County of Calaveras, Cal. Sealed bids will be received for the sale of the franchise up to February 3, 1911.

LOS ANGELES, CAL.—An agreement has been reached between the officials of the Los Angeles Railway Company and leaders of an improvement association who have been making a fight against the erection of car barns on the 13-acre tract south of Agricultural Park. The Railway Company will not build its barns there and will sell its 13 acres to be added to the park. Car barns will be built at the end of the Fifty-fourth street car line.

SAN FRANCISCO, CAL.—The United Railroads have men at work at Market and Sutter streets, engaged in removing part of the rails on the inner tracks and laying a straight rail to replace a part of the switch rail that has heretofore been there. General Superintendent Hibbs explained that the purpose of the work was largely to minimize the heavy noises occasioned by the jar and concussion of the Market-street cars falling upon the much-used rails of the switch connection. He says that it is the same character of work recently put in at the ferry for the same purpose, and will in nowise affect the position of the tracks as they have been. Neither is it the intention to lay a new switch, and the old one will not be taken out.

LOS ANGELES, CAL.—Orders were issued last week by Paul Shoup, vice-president in charge of operations of the Pacific Electric and Los Angeles-Pacific Companies, for the conversion of the Southern Pacific line from Los Angeles to Palms into an electric road. That part of the line between Palms and Santa Monica was converted some time ago. A trolley wire will be strung over the old S. P. tracks from Palms east through Sentous and University to Clement Junction, where the four-track Long Beach line of the Pacific Electric is reached. From there the line will run north to the Arcade station and the Pacific Electric's station at Sixth and Main streets. Over this line all freight for the Santa Monica bay district, whether it comes by land or water, will be transported.

SACRAMENTO, CAL.—That a branch line will be constructed by the Northern Electric, crossing the Haggin Grant tract from the main line eastward, skirting the south end of the proposed City Park crossing into Carmichael Colony, touching the Country Club tract and proceeding on to Fair Oaks and Orangeville, was decided last week at a conference between Northern Electric officials and persons interested in the great agricultural district. The branch will be built during the coming year, according to D. W. Carmichael. The branch will deflect from the main line at Del Paso Station on the Haggin Grant and run a little north of east toward the proposed City Park. Skirting the south point of the park site the road will turn due east across the grant. The survey for this branch has been completed, as has that for the line into Fair Oaks and Orangevale.

ILLUMINATION.

ELSINORE, CAL.—Mrs. M. A. Gardner and M. L. Camburn made application for a 50-year gas franchise.

CAMAS, WASH.—E. E. Goff of Portland has applied to the City Council for an electric light franchise and has secured a power site on the Washougal River, where he proposes to establish a 500 h.p. plant if the franchise is granted.

LA GRANDE, ORE.—James Lambirth, representing a company who proposes to put in a gas plant for La Grande, is here and has submitted a proposal for a franchise to lay mains through the streets and alleys. The plant and equipment and pipe connections will cost about $150,000.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company will erect a two-story and basement re-inforced concrete office building at Aliso and Center streets and an office building for the electrical department. The company is having plans made for a steel gas holder to contain 6,000,000 cu. ft. of gas.

LOS ANGELES, CAL.—One of the largest mortgage issues ever made in Los Angeles was given yesterday when the Southern California Gas Company issued $10,000,000 in first mortgage 40-year gold bonds. The Trust Company of America is named as trustee. Some of the money will be used to extend gas mains to San Bernardino and to complete the Redondo plant.

LONG BEACH, CAL.—The formal issuance of $400,000 worth of bonds recently authorized for the building of the Consolidated gas plant in Long Beach, was made at the meeting of the directors last week. The directors authorized the expenditure of $132,000 immediately. The remainder of the amount will be used in liquidating certain indebtedness and future use in the building of the plant.

BAKERSFIELD, CAL.—The California Natural Gas Company has purchased four acres at Palm and Oak streets in the Ellery Green tract at the southwestern limits of the city, and will there establish its buildings in connection with the delivery of natural gas into the distributing system of the local gas company. What the company will need of so much land is not known, as a reducing valve and a meter are about all the equipment it is likely to need at this point, so far as is known to the general equipment. The work of laying the pipe to bring the two systems to the connecting point is progressing well on both sides of the line, but the local company is expected to finish first. The holders at that point will be used to keep a stock of gas on hand against any emergency.

PORTLAND, ORE.—Expenditures aggregating $2,250,000 will be made by this company and the Pacific Power & Light Company during the coming year, according to announcement made by Guy W. Talbot, president of both concerns. Of this sum $750,000 will be spent in extending the mains and improving the plant of the Portland Gas & Coke Company. The remaining $1,500,000 will be used in the further development of the light and power company's service along the Columbia and Yakima rivers in Eastern Washington, making possible the irrigation of a large area. Work on the local improvements will be started early in 1911. About 200 miles of gas mains will be laid. Additions will be made to the local generating plant to accommodate the increased service. The new mains so far as possible, will cover those districts in which the city is planning hard-surface improvements but many of the suburban streets will also be served.

TELEPHONE AND TELEGRAPH.

RED BLUFF, CAL.—Word has been received here that the wireless telegraph station of the Northern California Power Company at Volta, near Manton on the Shasta and Tehama county line, was destroyed last week by a thunderbolt during a heavy storm. This is the first instance known here where a wireless telegraph plant has been struck by lightning. The Northern California Power Company maintains wireless plants at each of its hydroelectric power plants for the purpose of communicating with one another and with the home office in Redding in case the telephone lines are down or when storms make them dangerous.

FRESNO, CAL.—It is announced that extensive additions are planned for the local telephone system. The changes are to come soon after the first of the year and are to include an extension of the local system to the northwest of the city. It is stated that there is a possibility of extending the telephone lines to the Kearney Boulevard tract, now on sale. One of the main improvements contemplated is the laying of more underground cables in the downtown district. These will not displace the present overhead wires but it is not desired to string more wires above ground than necessary, and telephone officials hope that additional lines may be placed in conduits below street level.